RAILROAD GAZETTE

FRIDAY, OCTOBER 19, 1900.

CONTENTS

Relays for Automatic Signals—A Correction.

An obvious error, a clerical one, was made on page 674 of last week's *Railroad Gazette*, where we said that the Buchanan patent had been assigned to the Union Switch & Signal Company. It was assigned to the Hall Signal Company, which is, by this decision of the United States Circuit Court, made sole owner of the shunt circuit method of preventing an automatic electric signal from remaining fixed in the all-clear position in case the contact points in the track relay are fused by lightning. We have not heard whether or not there will be an appeal to a higher court, but meantime, the natural sequence will be an order enjoining the Union Company from making, selling, or using the device, and also an order for an accounting of profits and damages during the past five or more years. Railroad companies using the device without licenses from the Hall Company are liable to injunction, that, of course, depending on the policy of the Hall Company.

Contributions

A Storage Battery Lighting Accident.

Boston, Oct. 19, 1900.

TO THE EDITOR OF THE RAILROAD GAZETTE.

There recently appeared in some of the daily papers an account of an accident to a dining car lighted with electric storage batteries, which was caused by an explosion underneath and near the center of the car, where was located the box containing the storage batteries. A shaking up and severe fright was caused to a colored waiter who was standing over the spot at the time, but he escaped with only slight injuries. On the train being stopped it was found that the box was partly detached from the car, some of the hangers being broken, and there was a narrow escape from its falling on the track, with possible derailment of the train. This was undoubtedly caused by the faulty construction and arrangement of the box containing the battery cells, and since the use of storage batteries on trains is being greatly extended, it is well to call the attention of railroad companies to the importance of securing proper ventilation for all receptacles which contain storage batteries.

The action of the current when such a battery is charged (especially if the current is not stopped as soon as the charging is complete) is to cause the decomposition of a portion of the water in the cells, with the consequent liberation of hydrogen and oxygen gas, a mixture of which (as is well known) is violently explosive when in contact with a flame or an electric spark. A broken or partly broken connection between two of the cells of such a battery may easily produce a spark when the current is turned on or off (or at other times), and if the gases produced when the battery is charged accumulate in a confined space an explosion is quite certain to result, more or less violent according to the amount of gas in the receptacle. All danger from this source may easily be prevented by a few holes at the top of the battery box, arranged when possible on opposite sides so as to secure a draught through the box, and there need be no more fear of accidents from storage batteries than from any other appliances for lighting trains. This simple precaution is often neglected, however, and, while explosions are extremely rare, they are often possible.

The rules of some insurance companies require that where storage batteries are used the rooms or compartments containing them should be well ventilated, but the insurance people are not yet accustomed to supervise the use of electric appliances on moving trains. It is, therefore, for the interest of the railroads themselves to see that great care is used in the installation and maintenance of every such device. Such work should be under the direction of a competent expert, who should have charge of the laying out and installation of all electrical devices, and whose services can be well paid for by the amount of money saved in the operation and maintenance afterwards.

GEO. W. BLODGETT.

The Barschall Joint.

New York, Oct. 12, 1900.

TO THE EDITOR OF THE RAILROAD GAZETTE.

I beg to draw your attention to the incorrectness of the cut representing the Barschall joint in the article on Rail Joints by Mr. F. C. Schmitz, page 647, of your issue of Oct. 5, and the consequent incorrect statement in reference to same by Mr. Schmitz, that "the N. Y., P. & O. joint and the Barschall joint have many points in common."

I enclose a correct cut of the Barschall joint, and you will notice that the top and bottom of the filling piece is flat, not rounded or beveled. [This engraving appears in the article on joints published in this issue.—Editor.] This shape permits the ready insertion on rail ends which have been hammered down. Of still greater importance is the fact that the four edges or bearing surfaces of this filler are narrow and rounded, where resting on the main and auxiliary rail, and that the bolt holes are somewhat larger than the bolt itself, permitting a limited movement of the parts, and equalizing or distributing between them the weight of the passing train. The proof of this fact, that it is not a rigid, inflexible joint is seen on examining a filling piece in use for some time, which shows these rounded bearing surfaces to have become polished by this movement.

The independence of the auxiliary rail, resting as it does wholly on the ties and not at all on the base of the rail, as well as the filling piece and its peculiar shape, are the most essential and important features of the Barschall joint, and it differs therein from all other joints invented or used to date. The N. Y., P. & O. joint rests partly on the ties but also on the base of the rail, and therefore possesses more or less the objectionable features of all similarly supported fishplates or joints. A joint resting on the main rail must necessarily follow the movement or deflection of the rail ends caused by a passing load. It is just this undesirable fact that is done away with by the Barschall joint, and by no other. This is shown most clearly in the application of the joint to a bullhead rail.

It is the independent movement of the auxiliary and main rail that causes the smooth, noiseless, non-hammering passage of the wheel over the joint, even though the tires are much worn.

The theory that wheel-carrying joints are too rapidly destroyed, and cause hammering by the false flange of worn tires, is exploded by the actual experience with this class of joints made by the Royal State Railroad of Saxony. No other existing road has made the exhaustive tests and had the many years of experience of this road, and they some years ago equipped their entire line with this class of joint, owing to the savings thereby made. The Saxony joint also rests partly on the base of the main rail and must consequently possess the faults of other similarly supported joints, while the Barschall joint is free from these objections owing to its independence of the main rail.

If properly understood the superiority of the Barschall joint to all others must be apparent. It insures smooth, noiseless riding, decreased cost of maintenance, great saving in the wear and tear of rolling stock, etc., while if applied to old rails with hammered ends these same rails can be used until worn out in their entire body before replacing.

M. BARSCHALL.

Acceptance Tests for Locomotives.

TO THE EDITOR OF THE RAILROAD GAZETTE.

In a discussion of locomotive road-tests at the May meeting of the Western Railway Club, reference was made to the advantage which would result to all concerned if builders of locomotives were to determine the performance of engines before sending them out. While the tendency of the general discussion gave no emphasis to this suggestion, it is nevertheless worthy of careful consideration.

It is a noteworthy fact that a decade's progress in locomotive designing, significant as it is, has been confined chiefly to structural matters. To satisfy demands for greater power, locomotives have been made larger and heavier. Each proposed increment in size has presented difficult problems for the designer. In many cases he has been required to re-arrange important members and give new form to many details, but in accomplishing this he has succeeded in preserving in his design those elements of strength and simplicity which have hitherto characterized the American locomotive. At the same time he has greatly improved the general character of his design. Parts have been made stronger and at the same time lighter, materials entering into their construction have come to be more carefully chosen, and the workmanship expended upon them is now of a higher character than ever before. The result is that the modern locomotive is not only marvelously certain in action but it is a machine of so high an order that the service required of it is continually becoming more exacting.

From this brief review of results accomplished, it will be seen that progress in locomotive design has been finding expression entirely in the domain of mechanism. Nothing to which reference has been made can improve or in the least degree affect the thermodynamic action of the machine. Except for such progress as has been achieved in the matter of compounding, it is impossible to show that the locomotive of to-day delivers more work per pound of coal consumed than the locomotive of twenty years ago. Moreover, the conditions affecting the thermodynamic efficiency of a locomotive are so little understood that it happens not infrequently that a new type of engine is even less economical in its action than engines of an older type. Referring to this matter a prominent superintendent of motive power recently defined the situation by saying that he could point to a number of new locomotives, the cylinders, ports and valve gears of which had, in the working out of the designs, received unusual attention, but which now in service were "proving to be regular coal eaters." The adoption of the compound principle opens the way to important thermodynamic improvements, but the number of compound locomotives now running is still comparatively small. The slow progress which has attended their introduction is in part, at least, due to a lack of definite information concerning their performance.

An acceptance test would secure the purchaser of a locomotive against such gross defects as sometimes appear in badly fitted bearings, in imperfect draft appliances, in displaced cores in saddle and cylinder castings, and in the annoyance and loss incident to the process of "breaking the engine in." It would serve to satisfy the purchaser that he is getting all that he pays for. Such tests would be of advantage to the builder in many ways. Results derived from them would lead to the elimination of many of the uncertainties which now attend the process of designing. They would give the builder of a superior engine the advantage of a secure basis upon which to fix a guarantee. The advocate of the compound would soon be able to re-enforce his arguments by a specific performance guarantee which, being made with the full knowledge that a test would follow the completion of his work, would be entitled to very great respect.

A test before delivery would insure the builder against annoyance and loss arising in unfounded claims because of alleged defects which may be put forth by the purchaser after the delivery of the engine. It not unfrequently happens that locomotives of a new type when put in service fail to give the results which those responsible for their design had anticipated. The new engine may be larger than those previously employed and, if worked to its full power, may demand greater exertion on the part of its crew. Firemen may argue that if the new engines are forced to their full capacity the whole equipment of the road may soon be composed of similar engines, a change which would operate to greatly increase the severity of their labor. Engineers sympathizing with their firemen, may run with a partially open throttle or with the reverse lever close to the center. When the engine tugs lazily up a slight grade they may refuse to drop the lever a few notches, saying, "She's doing all she'll do now. If the lever is dropped she doesn't seem to free herself," and the word goes around that the new engine, although heavier and larger than those of an older type, will do no more work. The purchaser perhaps withholds payment, disputes arise, time passes, effort is lost, and ill feeling engendered before the real facts are apprehended and a proper remedy applied. All this could not be if the seller, the purchaser, and the operator all knew that the engine had been subjected to tests which had demonstrated its ability to do the amount of work expected of it.

It may be safely asserted that no one thing has contributed more largely to the present efficiency of the American pumping engine than the influence exerted by acceptance tests. The fact that such tests have been imposed has stimulated designers and builders, and the information derived from them has served as a sure guide to better work in all subsequent designs. Acceptance tests of pumping engines have been expensive but the benefits have been great. They have resulted not only in good engines but in higher ideals. Is it not now time when the locomotive should be subjected to a similar process?

The adoption of an acceptance test would require the addition of several paragraphs to such specifications as are now commonly employed. These might be somewhat as follows:

1. Upon its completion the builder shall run the locomotive under its own steam in the presence of a representative of the purchaser, upon a testing plant or otherwise, for the purpose of establishing its performance, as hereinafter set forth.

2. *Bearings.*—In case the fitting of bearings to their journals is such as to make it impracticable to run the engine at its full power, after being first started, the engine is to be subjected to such preliminary running as may be necessary to allow it to operate without interruption under the conditions of such tests as are hereinafter specified.

3. *Performance Under Conditions Approximating Maximum Traction.*—The engine should be run upon a testing

plant continuously for a period not less than two hours at a constant speed of 100 revolutions per minute (— miles per hour), and while thus run it shall develop a drawbar stress of — pounds, which stress is assumed to be the maximum which the engine is capable of developing at the stated speed. Under these conditions of running the consumption of steam by the engine per indicated horse-power per hour shall not be greater than — pounds; the capacity of the boiler and the action of the draft shall be such as will suffice for the generation of the steam required at a pressure which, throughout the test, shall not fall more than ten pounds below the stated working pressure for which the boiler is designed; and the efficiency of the boiler shall be such as will give an evaporation of — pounds of water per pound of — coal. Under these conditions, also, the combined action of the engine and the boiler shall be such that for each pound of coal consumed, — foot tons of energy shall be delivered at the drawbar, and the coal per mile run shall not exceed — pounds.

4. *Performance under Conditions of Maximum Speed.*—The engine shall be run upon a testing plant continuously for a period of not less than two hours at a constant speed of — revolutions per minute (— miles per hour), it being assumed that this is the maximum for which the engine is designed to run. While thus run, it shall develop a drawbar stress of not less than — pounds. Under these conditions of running the consumption of steam by the engine per horse-power per hour shall not be greater than — pounds; the capacity of the boiler and the action of the draft shall be such as will suffice for the generation of the steam required at a pressure which, throughout the test, shall not fall more than ten pounds below the stated working pressure for which the boiler is designed; and the efficiency of the boiler shall be such as will give an evaporation of — pounds of water per pound of — coal. Under these conditions, also, the combined action of the engine and boiler shall be such that for each pound of coal consumed, — foot tons of energy will be delivered at the drawbar and the coal per mile run shall not exceed — pounds.

5. If upon first trial of either of these tests, there is failure to complete the tests specified, through defective draft appliances, hot boxes, or any cause whatsoever, the defects are to be remedied and the process repeated until all prescribed conditions shall have been fulfilled.

6. *Balancing.*—With the engine running light upon a testing plant at a speed of — revolutions, which is assumed to be 20 per cent. in excess of the maximum speed for which the engine is designed, a small copper wire having a length of one and one-half times the circumference of the driver, shall be run between the driver and the supporting wheel, after which the wire shall present a continuous flattened section for a length which shall not be less than that of the circumference of the driver.

The reason for specifying "Conditions Approximating Maximum Traction" (Paragraph 2) instead of Condition of *Maximum* Traction grows out of the fact that when the traction is maximum, the chance of slipping of drivers makes it difficult to maintain constant conditions of speed. A speed of 100 revolutions a minute is usually sufficient to allow the full power of the engine to be developed without much risk of slipping. It will be noted, also, that the revolutions per minute are prescribed (paragraphs 3 and 4); the speed in miles per hour will depend upon the diameter of the driver. For a 48-in. wheel it will be 14.3 miles, and for an 80-in. wheel 23.8 miles. The facts which would be defined by the last sentence of paragraphs 3 and 4, would be derived by calculation from those previously set forth. The sentence, therefore, is not a necessary one but its presence would probably contribute to the convenience of the purchaser.

M. E.

TO THE EDITOR OF THE RAILROAD GAZETTE.

The plan proposed in the article "Acceptance Tests for Locomotives" is highly interesting, but will probably not meet with much favor either from railroad men or locomotive builders, if it is not wholly impracticable. The railroads would certainly have to pay well for this information in the end, and doubtless the locomotive builders would prefer to trust to the performance of engines in service rather than to be bothered with elaborate tests which necessarily would have to be made at their works.

In return for the expense of testing an engine in this way it is said the railroad would know whether there were any badly fitted bearings, any defects in the valves or steam passages, or briefly whether the engine would run. These are all things which are bound to be detected quickly in any event, and it is conceded that a testing plant is a failure as a place to "break in" engines. Then it is said the acceptance tests would show the value of certain special appliances, the advantages of compounding, and the water and coal consumption in terms of the horsepower. While this might be very interesting information, yet it would not show whether the engine in service on a particular division would haul a given number of cars; and it is thought that a service guarantee would be required in any event. Probably it is safe to say that the effect of any change in design, or the effect of any special appliance, not shown in the regular performance of the engine in service is not worth spending much money on, as the saving has to be made under service conditions. At any rate, only occasionally will special laboratory tests of locomotives be needed as a guide to designers, for which facilities are now available. The advantages of the acceptance tests are not apparent, and it is not believed anything important would be learned in such tests that could not be more easily found out after the engine was in service and earning money.

On the other hand, it is easy to see that if it were the general rule to require a laboratory test of each locomotive, there would be required a large plant and a large corps of attendants at each locomotive works. To take an extreme case, one firm of builders expects to turn out this year about 1,200 locomotives, or at the rate of about four engines a day. It would probably take at least two days with good luck to make the acceptance tests for one engine, and it is readily seen that a big locomotive laboratory would be required, if many engines were bought under these specifications. Serious inconvenience would be caused by delays in the laboratory, and there would be opportunities for endless disputes; it is hardly fair any way to test new machinery for efficiency until it has been run long enough to get the bearings and parts in good working order.

The acceptance test would seem to be something which would not appeal strongly to the locomotive builder. Then so long as railroads wait until the last minute to place orders for engines and almost demand immediate delivery, it is believed this plan cannot be seriously considered. ***

The Preservation of Railroad Ties in Europe.*

BY O. CHANUTE, *Past-President, Am. Soc. C. E.*

The writer . . . went abroad in October, 1899, and proposes to give to this Society some of the results of his inquiries in three different countries. The same methods are practised in the other countries of Europe.

Great Britain.

England took the lead in preserving timber by chemicals more than one hundred years ago. Her wooden ships forced this subject upon the attention of her builders and chemists, and thousands of experiments were tried with scores of substances. M. Paulet, in his book, "Conservation des Bois," enumerates 173 processes or methods. Most of them have proved failures, but some four or five proved to have value, as stated in the report of the Committee to this Society in 1885. . . . All antiseptics, save tar-oil, have now been abandoned in England, where "creosoting"† so-called, has grown to be recognized as the best process to use. Practically all ties now laid in Great Britain are treated. A few, cut in Scotland, are laid in their natural state, but at least 90 per cent. are imported and creosoted. . . .

Almost all the sleepers are of Baltic redwood from Russia, Sweden and Norway. They are cut in the late autumn or winter, and summer cutting is generally barred in the specifications. . . . The sleepers are floated and rafted down the streams to the shipping ports, much of the sap being washed out by this procedure. The logs or ties are then shipped to English ports, arriving some four to six months after felling, and they are frequently left to soak in water until sawed. . . . After being made into sleepers, generally 8 ft. 11 in. long, 10 in. face and 5 in. thick, containing 3.11 cu. ft., they are stacked in cribs, with 4 in. spaces between the sleepers and with sloping top layers, and allowed to season from four to six months more. Thus they are from 10 to 12 months, and sometimes 18 months, old when "creosoted." . . .

The specification for creosoted sleepers of the London, Brighton & South Coast Ry. is given herewith, in Appendix A, as fairly representing British practice. [Not reprinted.—Editor.] The mode of injection is practically the same on all roads; the "Bethell" process is used, in which there is no previous steaming, as the sleepers are already well cleared of sap, and seasoned, but the quantities of tar-oil injected and the results differ a little on various roads.

From an elaborate report of M. V. Hersenstein, presented to the International Railway Congress in London, 1895, Table No. 1 has been compiled. The kind of timber is omitted, as it is almost all "redwood"; and the reported cost is only applicable where long contracts previously existed, as tar-oil has much advanced in price since 1894, when the data were gathered. . . .

Most of the railroads are getting their creosoting done by contract, but the London & North Western is doing its own work, and reports the cost at 20 to 25 cents per sleeper. It also reports the longest life (16 to 20 years), save the London, Tilbury & Southend, a small road, of light traffic. The British are not injecting nearly as much tar-oil as the French roads, and they obtain a lesser life, as will be shown later.

Many of the results obtained with sleepers in England are due to the system of track. The rails are of the "bull-head" type, laid on chairs with about 108 sq. in. of bearing surface, and hence there is no cutting by the foot of the rail. The fastenings consist of trenails, of round drift bolts called spikes, and of lag screws, and are thoroughly effective.

France.

The forests furnish about 3,000,000 ties annually, leaving about 1,000,000 to be imported. Of the aggregate about 2,600,000 ties per annum are now consumed in renewals, and it is a notable feature that the number renewed has been diminishing for the past 15 years,‡ in spite of the fact that the mileage to be maintained has been constantly increasing. This result, which has been estimated as producing an annual economy of about $3,000,000, has been wholly due to the impregnation of the ties and to constant improvements in the processes. The French began treating wood about 1837 by the "Boucherie" process of expelling the sap by hydraulic pressure, using sulphate of copper as an antiseptic. Many of the railroads took this up, but most of them abandoned it about 1878, and the only road which had continued the use of this substance, the Midi, has now finally given it up in favor of creosote. The latter substance is now practically used exclusively by all the roads, save those of the state, which use a mixture of chloride of zinc and creosote, which will be more fully noticed when the German practice is described. "Burnettizing," *i.e.*, the injection of chloride of zinc alone, has been extensively used, but is now abandoned, as the zinc is found to wash out in time, especially in moist situations.

The kinds of wood used in renewals and construction have approximately been in the following proportions: Oak, 60 per cent.; beech, 22 per cent.; pine and sundries, 18 per cent. Of these, the supply of oak is diminishing, and the use of beech and pine is increasing. Formerly, the creosoting of oak was confined to sappy ties, but now all oak is treated, although but small amounts of tar-oil can be forced therein. The quantities of this substance injected have steadily been increased. While the British railroads were content with 22 to 30 lbs. per tie, the French injected from 31 to 40 lbs. in beech and pine, with correspondingly better results in duration, and they have lately still further increased the amounts. Thus the Ouest now requires 44 lbs. per tie; the Est, which does its own work, injects 60 lbs. of tar-oil per tie, and the Paris, Lyon et Mediterranée follows the practice of the Est.

The results heretofore attained upon the French railroads are given in Table No. 2, compiled from Mr. Herzenstein's report. It will be noticed that the life obtained is considerably in excess of that in England, and is nearly in direct ratio to the quantities injected and to the cost incurred. As this treatment is applied to beech ties, which cost some 70 cents each unprepared; to pine, costing 60 cents each, and to oak, costing from 95 cents to $1.10 each, it is seen that thorough injection produces important economies.

All the French roads but one have been creosoting by the "Bethell" process. The exception, the Nord, has been using the "Blythe" process, which consists in first heating the wood with a mixture of steam and creosote vapor, and then injecting by pressure about 24 lbs. of liquid tar-oil per tie. This method was adopted to economize the amount of this costly substance used. The specifications of this road are given in Appendix B [Not reprinted.—Editor], but the Chief Engineer of Maintenance of Way, Mr. Agnellet, stated that the quantity of creosote injected had lately been increased to 35 lbs. per tie, and that the present cost was 35.6 cents, as against 21 cents per tie in 1893. The road will probably go over to straight creosoting, and adopt the methods of the Est, which is recognized as doing the best work of that kind.

The Est does it own creosoting, and has two plants with an aggregate capacity of over 500,000 ties a year.

TABLE NO. 1.—ABSTRACT OF ANSWERS OF BRITISH RAILROADS TO MR. HERZENSTEIN

Number.	Railroad.	Number of sleepers annually renewed.	Process of preservation.	Amount injected.	Reported cost, 1894, cents.	Life, in years.	Cause of failure.
1	Belfast & N. Counties	....	Creosoting.	1 gall. per cubic foot.	12	15	Splits.
2	Furness	40,000	"	8 lbs. per cubic foot.	15	15	
3	Hall Barnoley	4,000 to 24,000	"	8 lbs. per cubic foot.	....	....	
4	Great Eastern	90,000 to 100,000	"	2½ galls. per tie.	16	12-15	Wear.
5	Great Northern	....	"	0.7 gall. per cubic foot.	13	12	
6	Great Southern & Western	....	"	3½ galls. per tie.	....	....	
7	London & North Western	300,000	"	30 lbs. per tie.	....	16-20	Wear.
8	London & South Western	170,000	"	2½ galls. per tie.	18	12	Wear and splits.
9	London, Tilbury & South End	Variable.	"	7 to 10 lbs. per cubic foot	....	25-30	Decay, etc.
10	Manchester S. & L.	20 per mile.	"	10 lbs. per cubic foot.	....	16	40% decay.
11	Midland	....	"	....	....	....	
12	North British	....	"	1 gall. per cubic foot.	14	....	
13	North London	....	"	28 lbs. per tie.	....	15	
14	South Eastern	97,000	"	28 lbs per tie.	....	8-9	Wear.
15	Taff Vale	17,000	"	1⅓ galls. per cubic foot	30	15	Natural causes.

Particular attention is called to the quantities (28 to 30 lbs.) of creosote injected per tie. The creosote used practically conforms to the specifications of Dr. Tidy, published in Mr. Boulton's paper, of 1884, and is to be entirely free from water, cone oil, shale oil, or other inferior oils.

*Extracts from a paper presented to the American Society of Civil Engineers, Oct. 17, 1900.

†Creosote, properly so-called, is a medicinal product of vegetable distillation.

‡The renewals averaged 3,072,605 ties per annum for the eight years 1878 to 1885 inclusive.

It purchases chiefly oak ties (95 cents) and beech ties (65 cents) upon rigid specifications, carefully enforced, and piles them up at its work to season. The piles are . . . inspected from time to time, and if cracks appear a hoop iron S is driven in at the end, or a hole bored and a bolt with washers is inserted. Oak ties are thus seasoned 15 to 20 months, and beech ties six months or more, and are further desiccated before treatment in special drying ovens from 60 to 80 hours. Repeated weighings show that the oak loses 16 per cent. of its weight in 12 months, and 2.7 per cent. more in the drying oven, while the beech loses 25 per cent. in 10½ months, and 3.5 per cent. more in the ovens. The use of the latter is deemed important, not only to expel remaining moisture and to insure regularity of treatment, but to obviate the chilling of the hot tar-oil upon its admission. For this purpose, the ties, loaded upon buggies, are run direct from the ovens, where the final temperature is 176 deg. Fahr., into the treating retort, whereupon, without previous steaming, a vacuum of 26 in. is produced, and the tar-oil then admitted. Before going into the drying ovens the ties are adzed for rail seat and bored for lag-screw fastenings. This is done by steam machinery, at a cost of 2 cents per tie.

The time occupied by a treatment is 2½ hours for oak and 3 hours for beech, of which time ½ hour is under a pressure of 75 lbs. per sq. in. for oak, and 1 hour of the same pressure for beech, the tar-oil being admitted at a temperature of 176 deg. Fahr. Under these conditions, the oak ties absorb from 14.22 to 16.65 lbs. of creosote each, and the beech ties take from 59.40 to 66.60 lbs. each. More could be forced into the latter, but this has been found sufficient, being, it will be noticed, double as much as is injected in England. . . . The total cost of treatment is 33.8 cents per tie for oak and 64.2 cents per tie for beech. This cost is about double that on other roads, but the results are correspondingly good, the creosoted oak lasting 25 years, and the creosoted beech being estimated to last 30 years in the track, as evidenced by data for 27 years, these data also showing that untreated oak lasts about 15 years. . . .

Germany.

By far the largest proportion of wooden ties laid in Germany are home grown, and almost all are chemically treated before laying. The raw ties of the first class are generally 8 ft. 10¼ in. long, 10¼ in. face and 6 5-16 in. thick, and cost $1.32 to $1.49 each for oak, and 82 to 90 cents for pine. White beech costs about $1 per tie, and red beech is in controversy. About 500,000 oak ties are creosoted annually, and about 1,600,000 pine ties are treated annually with chloride of zinc and creosote for the Prussian State Railroad, the whole of Germany probably taking about double those quantities. The German specifications are very strict, and the raw ties are minutely inspected. If there are incipient cracks, a sharpened band of hoop iron, bent into the shape of an S is driven in, and the ties are piled up in isolated piles, well ventilated, to season in the receiving yards at the treating works. There they remain, with casual inspection and more driving in of S-irons, or insertion of bolts if required, from 8 to 12 months before they are treated, having in the meantime become perfectly seasoned. . . .

Corrosive sublimate and sulphate of copper are now practically given up in Germany, and the State Railway also abandoned Burnettizing or the injection of chloride of zinc by itself in 1897. There are now three processes in use:

(1). Impregnation with chloride of zinc and tar-oil.
(2). Creosoting after seasoning and drying in ovens.
(3). Creosoting after desiccation in hot tar-oil.

The latest German specification (1898) for the first and third of these processes is given in Appendix C. [Not reprinted.—Editor.] . . .

Ties prepared by the zinc-creosote process, mostly pine, now last from 12 to 18 years, and creosoted ties, mostly oak, are expected to last from 24 to 28 years. In past time it was not always thus, some beech ties creosoted having perished about as soon as some ties injected with chloride of zinc alone, but the results developed upon the roads in Alsace-Lorraine, where beech ties, creosoted by the French, were found to be sound after 21 years of exposure, have again brought the Germans to favor the use of beech creosoted. . . .

An able paper by Mr. A. Schneidt, formerly Superintendent of the Alsace-Lorraine Lines, published in 1896 and 1897, shows that the chloride of zinc leaches out of the ties in time, and he advocates creosoting beech wood, either by the process of boiling in hot oil, or by the zinc-creosote process. He shows that the former is the more economical of the two, notwithstanding its greater cost, taking in view the high first cost of the untreated ties in Germany.

The prices paid in Germany for treatment, when reduced to American currency, are shown in Tables Nos. 3 and 4.

Table No. 3.

Timber.	With Zinc Chloride. 1st class. Cts. per tie.	2d class. Cts. per tie.	With Zinc Creosote. 1st class. Cts. per tie.	2d class. Cts. per tie.
Pine...........	15 60	12 00	19.20	14.40
Oak...........	12.00	9.12	15.60	12.00
Beech.........	18.80	12.48	20.40	15.36

Table No. 4.

Timber.	With Creosote and Drying Oven. 1st class. Cts. per tie.	2d class. Cts. per tie.	Boiling in Creosote. 1st class. Cts per tie.	2d class. Cts. per tie.
Pine...........	53.76	40.32	56.64	42.00
Oak...........	26 85	20.16	28.80	21.60
Beech.........	56 64	42.00	59.28	44.40

These prices are based upon the various amounts of the antiseptics which the different woods absorb, with careful work. As already stated, treatment with chloride of zinc alone has been given up, and boiling in creosote is growing in favor, as computations of annual charges for the renewals exhibit the fact that, notwithstanding the higher cost, impregnation with tar-oil is the most economical, in the long run.

In days gone by, some parties asked for guarantees before having ties treated by the zinc-creosote process, and in such cases Mr. Rütgers guaranteed the following lives:

Guarantee A.		*Guarantee B.*	
95% to last	10 years.	95% to last	10 years.
80% "	11 "	75% "	11 "
70% "	12 "	65% "	12 "
		50% "	13 "
		25% "	14 "

In computing the results, 5 per cent. of all ties treated is first deducted, to cover internal diseases which even the strict German inspection cannot detect, and the guarantee applies on the remainder alone, Mr. Rütgers agreeing to make the deficit good to the extent of either refunding the treatment price paid per tie, or treating another tie free of charge, at his option. He charges extra a bonus of 2.40 cents, a tie for this, and in the case of Guarantee B an extra bonus of 2.40 cents, a tie a year, for every year's life over the guarantee. In point of fact the character of his work is now so well established that his customers prefer to save the bonus and take their own chances as to life of ties.

Particular attention is called to the German specifications for creosote, and to the amount of chloride of zinc injected in connection therewith. The latter amounts to ½ lb. dry, per cu. ft.

The leading features of tie treatment in Europe are, therefore, the following:

1. Close inspection of raw ties, rejecting all defects.
2. Thorough seasoning for 6 to 12 months before treatment.
3. Constant testing of chemicals; strength, purity, etc.
4. Injection of liberal quantities of the chemicals.
5. Minute care in all the stages of impregnation.
6. Drying the ties after injection.
7. Methods of fastenings superior to our own.
8. Deep ballast, and thorough drainage.
9. Marking with dating nails, and careful records.

United States.

Thus it appears that the Europeans are now getting a longer service out of their ties than is obtained in the United States, Mr. Curtis having shown, in his paper read before this Society May 17, 1899, that an average life of 10 to 12 years is being obtained by the use of zinc chloride in this country. It would be possible to obtain a life of 15 to 30 years by the use of creosote, but it will be seen, from the figures given, that this would cost three to four times as much as zinc chloride. Thus, at present prices, it would cost 45 cents each to creosote according to English practice, and 15 to 16 years' life would be obtained; it would cost about 85 cents each to creosote after the best French or German practice, and 27 to 30 years' life would be obtained in thoroughly drained ballast; but it would not be economical to spend such sums upon ties costing 20 to 40 cents each untreated, while it is economical to spend them upon ties costing from 90 cents to $1.50 each abroad.

We must be content, therefore, either to allow our cheap ties to decay in the good old way, or to adopt for the present some of the cheaper and inferior methods which will produce shorter lives than obtained in Europe. By the light of past experience, those cheaper methods may be said to be three in number: first, straight Burnettizing; second, the zinc-tannin process, and third, the zinc-creosote process.

The writer is satisfied that the zinc-tannin process, as modified by himself in 1896, is superior to straight Burnettizing, and that the record of the next few years will demonstrate this, yet he is desirous of doing still better work, and he went abroad chiefly to investigate the zinc-creosote process. He now thinks that it is probably superior to the zinc-tannin process, although part of the greater life shown by records is attributable to other causes, such as the better ballast and drainage, and the better modes of fastening, as well as the climatic conditions. There are, however, some serious difficulties to be overcome before the process can be introduced here. Suitable tar-oil . . . is just now very scarce and high in price, so high that the freight, the leakage and the cost of the barrels render the cost almost prohibitory. The writer took over with him two samples of American creosote from different makers, and had them analyzed in Berlin, where they were pronounced by Mr. Rütgers' chemist quite unfit for tie preserving by the zinc-creosote process. . .

The principal dilemma, with reference to new processes, is the fact that it take half a business lifetime (15 to 18 years) to ascertain beyond peradventure whether an antiseptic or a method is thoroughly efficient to preserve ties in the track. . . .

The principal new processes are as follows:

1. The Creo-Resinate Process.—This process was described in a paper presented to this Society by F. A. Kummer, Jun. Am. Soc. C. E., on June 6, 1900. He proposes the use of creosote and resin, both preservative substances, to which a small percentage of formaldehyde is to be added. It may be questioned whether the latter volatile substance will stay in the wood, but the process is well worth trying, provided sufficient quantities of the chemicals are injected.

2. The Water-Creosote Process.—This consists in injecting an emulsion of creosote and water, and is being experimented with in Berlin. The writer expects to have samples sent to him this year.

3. The Hasselmann Process.—This consists in boiling the wood in a solution of the sulphates of copper and iron, with alumina and "Kainit." It possesses the merit of being cheap, and some ties prepared in that way have now been three years in the yard tracks in Berlin. Works have been started at Perth Amboy, N. J., to work this process.

4. The Allardyce Process.—This consists in the injection of chloride of zinc, followed by a second injection of tar-oil. A similar process was patented by the late J. P. Card, Assoc. Am. Soc. C. E., in 1882, but neither he nor the writer, who subsequently became his partner, ever succeeded in doing good and regular work therewith, notwithstanding many experiments.

5. The Naphthenic Acid Process.—This consists in injecting the wood with a solution of copper which has been dissolved in an acid obtained by a peculiar process in the distillation of Russian petroleum. It is stated to be theoretically effective and cheap, but American petroleum differs so much from the Russian in chemical constituents, that it is yet a question whether the naphthenic acid can be produced in this country.

Laboratory tests are sometimes misleading. They show, for instance, that bichloride of mercury and sulphate of copper, as antiseptics, are superior to chloride of zinc, and yet the latter preserves ties better. So with carbolic acid, which is stated by Mr. Boulton to be less efficient than the heavy oils of creosote. Such criticism, however, does not apply to the laboratory tests of the strength and purity of the materials used, and there are three features of the European practice which it would be well to imitate in this country. They are the following:

1. The careful testing, chemically, of the antiseptics to be injected.

2. The uniform injection of the wood with stated and liberal quantities of the antiseptics.

3. The adequate seasoning of the wood before treatment. This is now generally neglected in the United States, and yet it is the most important requirement in obtaining good results, for, otherwise, the antiseptic will not be uniformly distributed, and some portions of the ties will decay before others.

Originally, at the works of the writer, ties were treated in the order of their arrival, and without regard to their condition. The result was that in six or seven years some were found to decay much in advance of others. Experiments, made by weighing considerable numbers of individual ties before and after treatment, disclosed the fact that there were great differences in the absorption, and in later years arriving ties have been tested, sorted out, and seasoned in case of need, so as to obtain uniformity of treatment, with the result that the average absorption of chloride of zinc is now two and one-half times as much as it was 14 years ago.

From his experience, the writer is satisfied that if the ties are injected with reasonable uniformity and with the equivalent of ½ lb. of dry zinc-chloride to the cubic foot, as is done in Germany, straight Burnettizing makes them last 10 to 12 years in the track, with ordinary exposure; while perhaps half of that quantity will produce

TABLE NO. 2.—ABSTRACT OF ANSWERS OF FRENCH RAILROADS TO MR. HERZENSTEIN

Number.	Railroad.	Number of ties annually renewed.	Kind of wood.	Process of preservation.	Amount injected.	Cost, 1893, cents.	Life, in years.	Causes of failure.
27	State..................	161,213	Pine.	Zinc, creosote.	66 lbs. per tie.	..	10-15	Decay.
27	"	....	Oak.	Zinc, creosote.	9 lbs. per tie.	..	......	
28	Eastern..............	356,650	Beech.	Creosote.	60 lbs. per tie.	42	25-30	Wear.
29	Meridional..........	10%	Oak.	None.	....	..	......	
30	Southern............	284.511	Pine.	Sulph. of copper.	0.4 lb. dry, cu. ft.	..	8-10	Decay and wear.
30	"	....	Oak.	Creosote.	9.5 lbs. per tie.	..	10-15	Since increased.
31	Northern............	285,000	Oak.	Creosote.	11 lbs. per tie.	11	......	
31	"	....	Beech.	Blythe Process.	24 lbs. per tie.	21	......	Going over to straight creosot'g.
32	Western............	242,050	Oak.	Creosote.	11-13 lbs. per tie	..	15-20	Decay and splits.
32	"	....	Beech.	Creosote.	31-33 lbs. per tie.	..	18-25	Now inject 44 lbs.
33	Orleans.............	460,000	Oak.	Creosote.	12 lbs. per tie.	..	15	Decay.
33	"	....	Pine.	Creosote.	35-44 lbs. per tie.	30	13-16	"
34	Paris, Lyon & Med....	700,000	Oak.	Creosote.	10-11 lbs. per tie.	12	12	Decay and cutting.
34	"	....	Beech	Creosote.	26-35 lbs. per tie.	18	Prior to 1890.	Now copies Eastern.

the same result in the more arid regions of the United States; that the new zinc-tannin process will impart to them a life of 12 to 14 years, and the zinc-creosote process may extend this to 14 or 16 years. It cannot, however, be too strongly insisted upon that the work must be well and skilfully done, for, otherwise, the results are sure to be disappointing.

Some Notes on Rail Joint Fastenings.

BY F. C. SCHMITZ, ASSOC. M. AM. SOC. C. E.

(Continued from page 669.)

PATENTED JOINT FASTENINGS.

Let us now proceed to discuss the prominent patented and experimental joints, subdividing them into classes or types, and see wherein they conform or fail to conform to the conditions just laid down as governing their efficiency. The table is composed of the joints in question, also the angle bar for comparison.

CLASSIFICATION OF PATENTED JOINTS.

No.	Type	Name	Maker	Address
1	Deep splice for 100% rigidity. No bearing under base of rail.	Thomson 100% Bonzano 100% Churchill	P. R. R. Shops Illinois Steel Co. Diamond State I. and S. Co.	Altoona, Pa. Chicago, Ill. Wilmington, De.
2	Truss or clamp around base of rail. No support under rail head.	Fisher Triple Long Truss	Clark Fisher Rail Jt. Co. Long Truss Rail Jt. Co.	Trenton, N. J. Chicago, Ill.
3	Splice carried around rail base and supporting same. 2 pieces.	Continuous American Stand. Atlas	Continuous Rail Jt. Co. Chisholm Moore Mfg. Co. Atlas Railway Supply Co.	Newark, N. J. Cleveland, Ohio. Chicago, Ill.
4	Plain splice, bolted or clamped to rail	Pope Permanent Common Angle	J. L. Pope	Cleveland, Ohio.
5	Bridge of auxiliary rail, carrying wheel over joint.	Barschall N. Y. P. & O. Expmt.	Penna. Co. Shops N. Y. P. & O. Shops	Ft. Wayne, Ind. Meadville, Pa.
6	Casting around rail.	Falk Cast	Falk Rail Jt. Co.	Milwaukee, Wis.
7	Splice supplemented by a base supporting devise (shoe or plate).	Weber C. & N. W. Ry. Std. C., B. & Q. Expmt.	Weber Rail Jt. Co. C. & N. W. Shops C., B. & Q. Shops	New York, N. Y. Chicago, Ill. Chicago, Ill.

TYPE NO. 1.

The Thomson 100 Per Cent. Joint, Fig. 35, is strictly an angle bar splice, extended below the base of rail, to give the necessary depth at the center of the bar and to make its vertical rigidity 100 per cent. of the stiffness of the rail at its center, considering each as a beam fixed at the ends. The fastening shown in Fig. 35, has wide flanges bearing on the ties. A second type has been brought out having all that part previously bearing on the tie, cut out as is shown at A in Fig. 35. The reason given for the change was that the joint had too much lateral stiffness, resulting in excessive wear of the rail opposite the joint. The discussion of this point, however, will be deferred until the type is criticized.

The Bonzano Rail Joint, Fig. 36.—The Bonzano joint is the latest development of the angle bar, carried below the base of the rail for additional depth. The fundamental idea in the Bonzano joint is the construction of an angle sufficiently deep in the center section to insure 100 per cent. of the strength developed in the rail body. The joint is different from the Thomson joint, inasmuch as the central rib is bent down and connected to the tie section by a strong gusset section.

The Churchill Joint.—The third joint of the type called No. 1 in the table, is the Churchill rail joint, Fig. 37. This latter joint varies from the others in one important detail. The first two provide no bearing whatever for the base of rail. The Churchill, as may be seen in the cut, does. The base plate is held in position by a wedge action against the deepened angles.

The class of joints just described (No. 1) offends against the conditions laid down as follows:

(1) The efficiency of the joint depends directly on the tightness of bolts; the heavier the load on the bars, the more stress in the bolts.

(2) The bearing area in this class (excepting the Churchill) as in the plain angle bar, is confined to the narrow strip under the head of rail, and the somewhat wider area on the upper side of the base. By their great vertical rigidity they restrict a certain amount of bending, consequently lessen the cutting tendency. They do not eliminate it by any means.* The Churchill joint in this respect has a slight advantage over its fellows in that it has a plate supporting the rail from beneath. This plate, however, is certain not to be efficient because the slightest loosening of the bolts holding it in place allows it to drop enough to destroy its bearing power.

(3) The irregularities in rail sections are taken up in joints of this class, as well as in any joint bearing only in two places.

(4) Condition No. 4 is very closely related to condition No. 1. The joint that offends in No. 1 and No. 9 cannot possibly be efficient in No. 4 because as soon as a little play exists between rail ends, they cease to act together.

(5) and (6) Class No. 1 fulfills conditions Nos. 5 and 6 perfectly.

(7) It is necessary always to space joint ties in applying joints of class No. 1. This means that in laying the steel the two joint ties must be carefully placed, to allow the extended portion to go between them. In relaying steel on existing track the above process is very expensive and sometimes impossible. Especially is it vexatious if the new rail is not the same length as the old. Furthermore the use of supported joints is impossible. The extended rib must be between two ties and can be in no other place. The extension below the base of rail makes good tamping very difficult.

(8) Class No. 1 requires no special rail end.

(9) Joints of class No. 1 are too rigid to fulfill condition No. 9. As elsewhere explained the rail ends, for a deflection equal to that obtained in the body of the rail, will carry from 30 per cent. to 40 per cent. of the load. The perfect joint therefor should carry between 60 and 70 per cent. of the burden, depending on the moment of inertia. Why provide two paths for a stress to traverse when one will do? Even granting that the joints should have 100 per cent. of the strength of the rail, the diagram, Fig. 38, shows very clearly that there is a waste of metal in the center section, because the side section is weak. The theoretical line should nowhere fall below the actual line. The type has in its weak section but 90 per cent. full strength.

There is one feature in the construction of at least two of the joints in class No. 1, which, while not a violation of any requirement is nevertheless to be avoided. This is a wide bearing on the tie. In taking this point up for discussion, the following extract from an article by W. Fisher Ellis, of Boston, Mass., seems to hew very closely to the line. Mr. Ellis says: "Another frequent cause of failure in the angle bar type is shown in Fig. 39 and arises where the tie is cut by the base of rail and not by the foot of the angle bars. The trouble can only be avoided by the most careful attention and inspection. An attempt has been made on some railroads to alleviate this trouble by making the foot of the angle ¼ in. above the base of rail, but this only aggravates the difficulty, as such joints have to carry a load similar to a person with no support under his feet, but hung up by his ears." It is very easily seen that, with joints having the base much wider than the angles in Fig. 39, the trouble will be augmented many times.

TYPE NO. 2.

The Fisher Triple Fish Joint, Fig. 40.—The Fisher joint supports the rail entirely from below by means of a heavy T plate bolted to a peculiarly shaped angle, by three U bolts. The heaviest of these bolts is placed just at the rail ends, requiring that the outside corners of the rail bases be notched. The angle bars are made to fit closely against the web of rail, but have no bearing against the head of same. Two small track bolts secure the angles to the rail ends, insuring good alignment and surface during the process of laying. The joint is an improvement on the earlier designs of Mr. Fisher, inasmuch as the earlier joints broke many rails. The enormous stress induced in the base of rail, caused them to break as shown in the sketch, Fig. 41. In one instance, 66 per cent. of a certain lot of rail, taken out of track after five years' service with Fisher joints, were broken or cracked. The new joint has not been in service long enough to show the presence or absence of any defect of the kind mentioned.

The Long Truss Rail Joint, No. 42.—The Long truss joint is a combination of a splice and a supporting truss under the rail base. Like some of the other less prominent joints, it is necessary, in relaying rail on a busy track, to lay with the angle only, the truss being applied after the ties have been properly spaced and the rail brought to line and surface. This means that the incomplete joint is usually subjected to a load and it is doubtful if the application of a truss afterward can correct the damage done. A further criticism of the joint is, that too much of its efficiency depends on the skill of the trackman in adjusting the nuts of the truss bolts. If but one of these nuts work loose the whole efficiency of the device is impaired, and if two become loose the supporting truss is at once but a rattlebox. Undoubtedly if the joint is carefully fitted and adjusted, it is much superior to the angle bar joint in both line and surface, and, as long as it is kept tight gives good service. Freezing weather, especially with poor ballast, is always a very severe condition for joints of this type.

Joint fastenings of the second class may be made to comply with condition No. 1, to a certain extent, because the bolts on which their efficiency depends do not act in such a way as to restrict expansion and contraction. However, the whole efficiency of the device does depend on the tightness of bolts and nuts, consequently it cannot be said that condition No. 1 is fulfilled.

If the joints are kept tight they fulfill No.'s 2 and 3. This hardly needs comment as to No. 2. The first of the two devices shown does not take up the irregularities in rail sections as well as the other. The reason for this is that the angle does not bear against the head of rail. As explained elsewhere, a considerable proportion of the irregularity in rail sections consists of a twist in the web, due to being cooled on their sides. Any joint to absorb such a twist must not bear against the twisted portion. The second device, therefore, fulfills No. 3 better than the first. In condition No. 4 we again have a variation in the two devices in favor of the second. This is true because the second has the aid of an angle bar in resisting bending in both directions, while in the first the sole function of the angle is to hold the rail webs in line, and prevent the rail ends from creeping out of the joint. As a result the first breaks many rail bases as shown in Fig. 41. Neither device is strong against bending upward and cannot be said to fill the requirement mentioned. Both fulfill No. 5 perfectly, but neither joint fulfills No. 6. In this type of joint it is necessary always to lay the rail with the angle bar only, bring the rail and ties very carefully to line and surface, after which the rest of the device is applied and the whole brought to adjustment. In relaying steel on existing track, it is almost a certainty that there will be a train or two over the rail before the joints can be made complete. This is always very hard on the fastening and is a weak point in its construction. Furthermore the joints are not simple, easy of application, and they do very seriously depend on the adjustment of one part against the other. This type of device does require that the ties be spaced before application, a vexatious detail.

The joints fulfill condition No. 8 perfectly. Regarding No. 9 it is impossible to compute the rigidity of this type, because, being adjustable, the vertical stiffness depends entirely on the adjustment of parts. If they are loose the rigidity is very low, if tight they may be quite high. Inasmuch as they are at all times uncertain, they cannot be said to fulfill the condition.

Under the head of special criticism, it seems but reasonable to take up the feature of tightening bolts. The whole efficiency depends on bolts that are very difficult to tighten properly. They are of odd sizes and require a special wrench. Furthermore, it is always hard to tamp around a joint that extends so far below the surface of ties.

TYPE NO. 3.

The Continuous Rail Joint, Fig. 43.—The Continuous joint is an angle bar splice, designed to overcome the inherent weaknesses of the ordinary angle, without sacrificing any of those features that have made the use of the latter so universal. It is rolled of the same steel as the regular angle, and is bolted to the rail in a similar manner. It can be and is made to accommodate any standard as to length, bolt spacing, slotting, etc., and is applicable for both supported and suspended joints.

The Continuous joint has only been made possible by careful consideration of the mechanical problems of rolling. The machinery used in its manufacture is unique and it has been brought to its present high state of perfection only after long study and many costly changes. The Continuous is the only base bearing joint in two pieces that has ever been rolled.

The American Standard Rail Joint, Fig. 44.—The American Standard joint is another of the boltless type of fastening made of cast malleable iron in two parts. Lugs on one bar pass through holes in the web of the rail and lock into tapering grooves on the other, thus preventing creeping. The two bars are held together by tapering surfaces below the rail base, which cause the bars to approach each other as they are driven on to the rail. The joint is usually made 10 in. to 11 in. long for use as a supported joint resting on one tie. It can be adapted to the suspended system of laying however. The surfaces bearing against the rail are ground to fit.

The Atlas Rail Joint, Fig. 45.—The Atlas joint, like the American standard, is a cast malleable iron joint, and all criticisms of one in regard to material and method of manufacture apply to both. The Atlas joint, however, has three distinct advantages over the American standard: It does not depend on sliding surfaces for fastenings: it can be made long enough to be theoretically correct: it does not require an exact fit at so many points.

Type No. 3 fulfills condition No. 1 more readily than any other type of fastening. This may be seen from the following simple calculation:

Let P = a load applied at the joint, Fig. 46. Elsewhere it is shown that, under normal conditions 65 per cent. of P is carried to the ties by the splice; 35 per cent. of P is carried to the ties by the rail ends. The angle under the head of rail is 13 deg.; therefore, the horizontal component with plain angles i.e. (the pull in bolts)

$$= \frac{65\ P}{4} \ldots\ldots\ldots\ldots A$$

Since, with joints of type No. 3, the stress, .65 P, must pass from the joint into the tie through the base plate, and the friction of the base plate against the tie is roughly ¼ the load, then the resistance to side motion, *i.e.*, assistance to the bolts, $= \frac{.65\ P}{4} \ldots\ldots\ldots\ldots B$

A further assistance is given the bolts because all the load carried directly to the tie by means of the rail ends passes through the base plate, developing friction $= \frac{35\ P}{4} \ldots\ldots C$

Adding B and C and equating with the pull developed (A), we find that the friction entirely overcomes the pull. The elasticity of the metal, naturally, allows some stress in the bolts. It is, however, small. For the reasons above outlined there are but few loose bolts found on joints of this class.

The result of the above is that bolts may be left looser and expansion and contraction be made much easier. Furthermore it shows conclusively that the greater the load the closer the bar clings to the rail and that the only function of the bolt is to draw the bar into place when applied.

Type No. 3, while having no greater bearing against the rail, has this signal advantage, that the base plate is

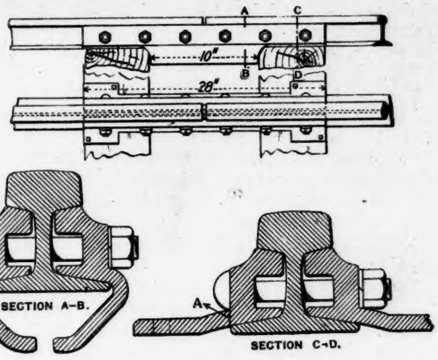


Fig. 35.—The Thomson 100 Per Cent. Rail Joint.

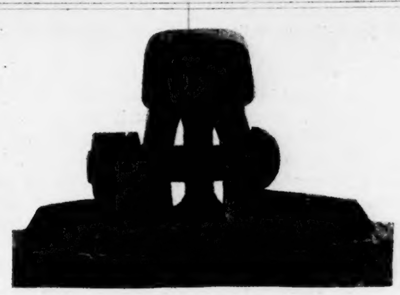


Fig. 39.

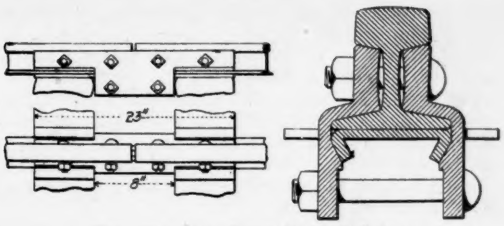


Fig. 37.—The Churchill Rail Joint.

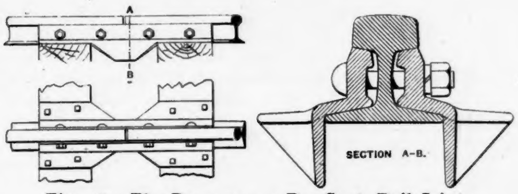


Fig. 36.—The Bonzano 100 Per Cent. Rail Joint.

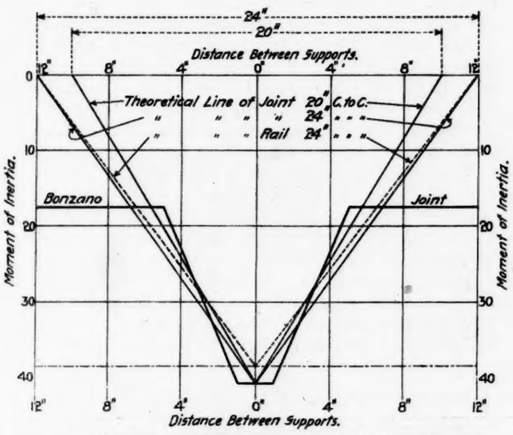


Fig. 38.—Diagram of Moments of Inertia—Bonzano Joint and 100 lb. P. R. R. Rail.

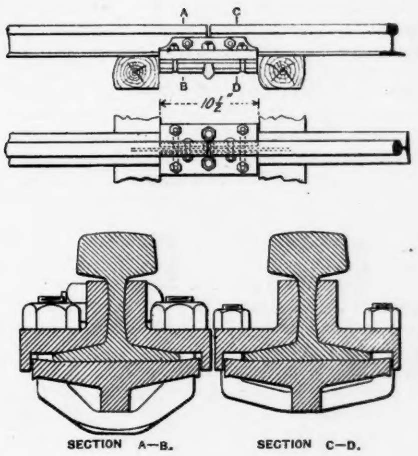


Fig. 40.—The Fisher Triple Fish Rail Joint.

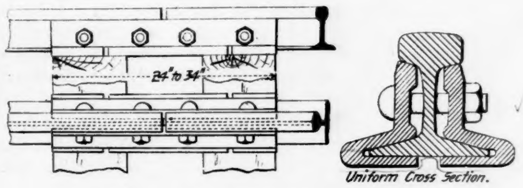


Fig. 43.—The Continuous Rail Joint.

Fig. 41.

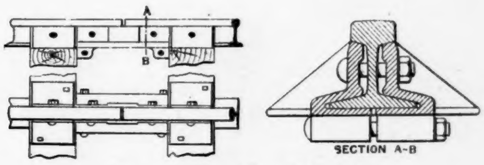


Fig. 45.—The Atlas Rail Joint.

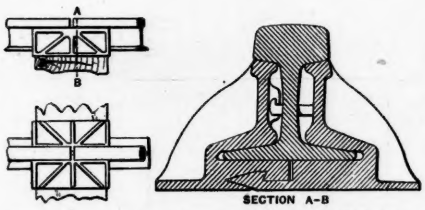


Fig. 44.—The American Standard Rail Joint.

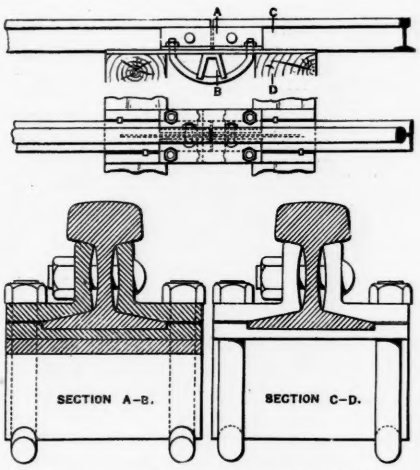


Fig. 42.—The Long Truss Rail Joint.

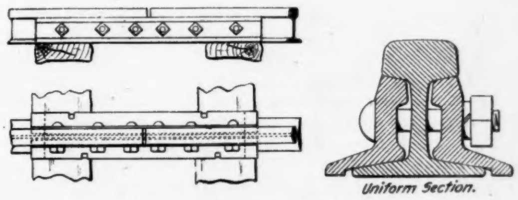


Fig. 48.—Common Angle Bar.

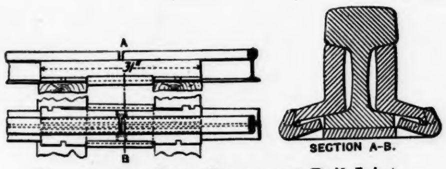


Fig. 47.—The Pope Permanent Rail Joint.

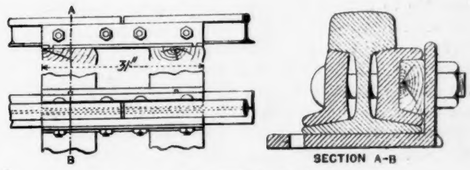


Fig. 52.—The Weber Rail Joint.

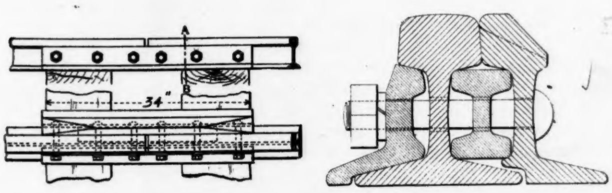


Fig. 49.—The Barschall Rail Joint.

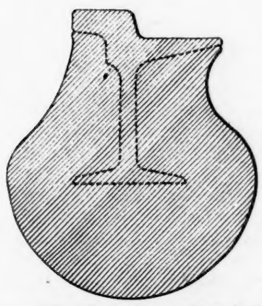


Fig. 51.—The Falk Cast Welded Joint.

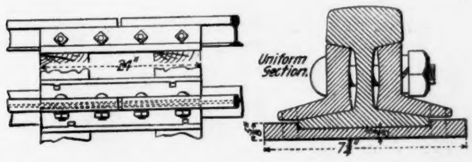


Fig. 53.—The Chicago & Northwestern Ry. Rail Joint.

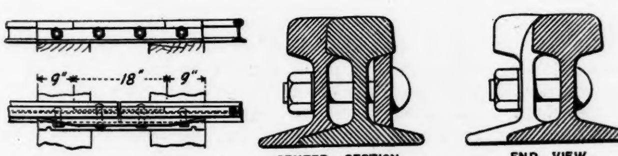


Fig. 50.—Experimental Joint—N. Y. P. & O. Ry.

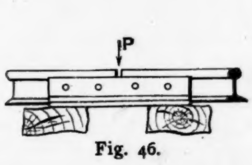


Fig. 46.

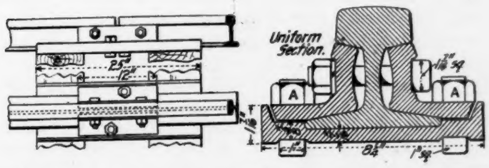


Fig. 54.—The Chicago, Burlington & Quincy Experimental Joint.

VARIOUS TYPICAL RAIL JOINTS.

always in position and does not in any way depend on the joint ties for its efficiency. Being integral with the rest of the bar, a load applied at any given point on the joint always produces in all parts of the bar the stress for which it was calculated. This means that a load applied to the base plate produces in the whole joint the same stresses that the same load would produce if applied to the head of the bar. As a consequence the base plate in this type offers more relief to the cutting of the head than in any other type.

This type of joint takes up irregularities in three surfaces as compared with two in the angle. Therefore it more nearly eliminates them than does any other type.

The increase in the depth of bar over that of the common angle gives it from 60 to 70 per cent. of the strength of the rail, a condition that has been shown elsewhere as being the ideal condition. Inasmuch as the bars are all of one piece they resist upward bending equally as well as downward. Therefore they fulfill condition No. 4, and produce a track in which the deflection at all points is nearly the same, which is the ideal track. Conditions 5 and 6 are fulfilled perfectly. Condition No. 7 is not fulfilled perfectly because it is necessary to cut the ties 3/8 in. more or less to accommodate the base plate. In relaying steel this is often a disadvantage, in laying new track it does not appear. It is a minor matter, however, as most joint ties require adzing anyway before the new steel is put on and it is very easy to take off the additional 3/8 in. Type No. 3 fulfills condition No. 8 perfectly. The discussion of condition No. 4 shows that this type fulfills No. 9 as well. Therefore, no discussion of this point is necessary.

Everything considered, it is along the lines of the type under discussion that the joint of the future is to be evolved. Between the joints composing the type, at present on the market, there is considerable difference in the process of manufacture. It is clearly impossible to cast as closely to a given measurement as it is to roll. Consequently the rolled section has at once a handicap that places it ahead of its competitors. That this is appreciated by railroad men is evidenced by the fact that the vast majority of joints of this type in use are of the rolled type.

TYPE NO. 4.

The Pope Permanent Rail Joint, Fig. 47.—The Permanent joint is a boltless angle bar splice. The angles are held to the rail by a clamp passing under the rail base and sliding on tapering surfaces planed on the foot of the angles. A lug in the center of the clamp fits into a notch cut out of the rail ends, to carry the creeping tendency from rail to angle, thence into the ties, as in an ordinary splice.

Common Angle Bar, Fig. 48.—The common angle bar splice hardly needs introduction or comment. Its virtues and faults have been studied ever since its introduction, and it is here reproduced simply as a representative of a certain type of rail end fastening.

Type No. 4 does not fulfill either condition No. 1 or No. 2. It is a well known fact that the common angle requires constant care and watchfulness regarding the tightness of bolts in order to get good service, while the Permanent joint risks all on the tightness of its clamp.

The total bearing area in each instance is that of angle under head of rail, an insufficient bearing as anyone knows. The angle fills condition No. 3 as well as any joint, and this is one of the secrets of its great popularity. Could an angle be made stiff enough to do its work perfectly as a splice it would fulfill No. 4. It is clearly impossible to get the required stiffness, consequently it cannot do the work.

Type No. 4 fills condition No. 5 perfectly. Regarding condition No. 6 there is a radical difference in mode of attaching the two devices to the rail. The first depends on the adjustment of the base clamp on the angles and consequently does not fill the condition. The second is bolted and does not fulfill the condition.

Type No. 4 fulfills both No. 7 and No. 8 perfectly, but it does not at all fill condition No. 9, and herein lies the whole condemnation of the angle bar splice. The heaviest angles rolled have but about 35 per cent. of the strength of rail when they should have at least 60 per cent. The consequence is that both rail and splice are carrying more load per sq. in. than is legitimate and both suffer. This last condition would condemn the type absolutely had it no other weakness. Excess strength may be tolerated, too little, never.

TYPE NO. 5.

The Barschall Rail Joint, Fig. 49.—The fundamental feature of this joint is the auxiliary rail, planed as shown in the cross section and placed outside the main rail, carrying the wheel over the rail ends. To insure that the auxiliary and main rails act together, a filler is placed between them bearing under the heads and on the bases of both. A standard angle inside the main rail completes the device. As is shown in the sketch, there is but one condition of wheel and rail under which the joint is efficient. A new wheel rides the main rail without touching the auxiliary, while with a worn driver the reverse is true.

The N. Y., P. & O. Ry. experimental joint was built by the N. Y., P. & O. shops for use on that road in 1880. Like the Barschall it consisted of an auxiliary rail bolted to the outside of the main rail forming a bridge to carry the wheel over the break. The device is shown in Fig. 50, which is a reproduction of Fig. 22 of a former paper. The differences between these two joints are the presence of a filler block in the Barschall joint, and the fact that in this joint the auxilliary rail rests entirely on the ties and not on the flange of the main rail.

Discussing the efficiency of the type, it cannot be accurately calculated in its effect on the bolts. It is certain that it does not depend as absolutely on the bolt as an angle bar, neither is it as free from the bolt as is type No. 3. On the whole, it may be said not to fill No. 1 because when a worn wheel strikes the auxiliary rail it is lifted nearly free from the main rail and causes the auxiliary rail to tip inward at the top, in which case the stress in the bolts is materially increased.

Type No. 5 fulfills conditions No. 2 and No. 3 in a novel way. Instead of having bearing area enough to prevent cutting of rail head into joint, it lifts the load bodily from the rail head and carries it independently. Instead of overcoming the irregularities of the rail, it is in such a position that the irregularities of the rail section do not enter into its efficiency.

Type No. 5 does not fulfill condition No. 4 in a satisfactory manner. To resist bending upward there are the filler block and the inside angle, neither of which is held rigidly enough to do the work perfectly. The N. Y., P. & O. joint had not even the filler block.

It is in condition No. 5 that the joint most particularly offends. As is shown in the sketch of the Barschall joint the worn driver must lift to ride the auxiliary rail, a condition that should have no existence. A lift and corresponding drop of even 1-16 inch is very severe on rolling stock at high speeds if the lift must be made every 30 ft. While the criticism is not of a vital point it is very important.

Conditions No. 6, No. 7, No. 8 and No. 9 are fulfilled by this type as well as in the others. It is not possible, however, to get the close adherence to the rule in No. 9 that is obtained by other types. It is not weak, however, and is thus on the safe side.

TYPE NO. 6.

The Falk Cast Welded Joint, Fig. 51.—The Falk joint consists of a mass of cast iron applied in the field, in a molten state. During the process of casting, the rail ends are held rigidly to line and surface by screw clamps. Before the joint is poured all extraneous material is cleaned from the rail ends by a sand blast. By this process the rail and joint are welded so completely that it is difficult to distinguish the line separating rail web from joint, when the rails have been so sawed as to expose a cross section. In many instances expansion joints are put in at intervals of 500 ft. or 1,000 ft. as a safeguard against excessive stress in the rails during cold weather.

The conditions of temperature changes in street railroad work and steam road work are so different that it is impossible to draw any comparison. A continuous rail with no allowance for expansion is perfectly feasible in a street with sharp right angle turns and pavement to pull against. It would not do at all for track on ties, bedded in ballast and free to move laterally. It would, obviously, be impossible to maintain the alignment of curves under any such arrangement. Criticism of the type is difficult because it has never been tried on roads operated by steam. It is a foregone conclusion that it is not applicable to that kind of construction. The joint will be looked at therefore from a street railroad standpoint.

Condition No. 1 is not necessary. Type No. 6 fulfills conditions Nos. 2, 3, 4 and 5, as well as they can be fulfilled. This type does not fulfill condition No. 6 at all. It is not easy of application and renewal. It requires an extensive plant to put on *one* joint that must be kept always ready for operation. Heat enough to melt iron must be generated, a sand blast used and much that is expensive endured.

Again, rail in a piece of track having welded joints can never be used for relaying, a fact that appeals very strongly to railroad men. Further the rail is good for scrap, only when broken up into lengths that can be easily handled. This breaking up process is often expensive and slow. Apropos of this latter criticism there is in use in St. Louis a machine that breaks the rail into 7-ft. lengths as rapidly as it tears it from the street. In such length the scrap is worth enough more to pay for the operation of the machine and leave a small margin. Replacing a broken joint is expensive, because of the cost of firing up the cupola, etc. This applies as well for cutting in a switch.

This much must be said in its favor, however, it does not require an adjustment, and when once in place is out of the hands of track walkers.

This type, like many others, requires special attention to ties before application, inasmuch as they must be accurately spaced before the joint can be put on. Again, in street practice this does not work a serious hardship as it is the usual practice in relaying steel to abandon the track for the time being.

Type No. 6 does fulfill condition No. 8 perfectly. Condition No. 9 is fulfilled in street railroad practice because it is impossible to get the joint too stiff, there being little wave motion in a 9-in. girder rail on solid foundation.

TYPE NO. 7.

The Weber Rail Joint, Fig. 52.—The Weber joint is a combination of angle bar splices of modified form and an L base plate, the whole being held together by long track bolts. A wooden filler, placed between the L base support and the channel angle bar, acts as a nut lock and cushion. The spikes are driven through the base plate on one side in a slot on the other, to prevent creeping.

The Chicago & Northwestern Railway Joint, Fig. 53, was brought out by that company in 1893, and is here introduced as being typical of all those joints having base plate supplements to the plain angle bar joint. As may be seen there is no connection between angle and base plate, other than the spike.

The Chicago, Burlington & Quincy R. R. Joint, Fig. 54, was designed by Mr. Delano, of that road, for experimental use in 1893. It is composed of a pair of angles bolted to the rail in the usual way and shaped as shown in the figure, with a long horizontal leaf, extending far enough beyond the rail base to accommodate the hook bolts A-A. The office of the latter is to compel the base plate and angles to act together.

Joints of type No. 7 do not fulfill condition No. 1 because in each case they depend on the action of the bolts for efficiency. The heavier the load the greater the stress on the bolts.

Regarding condition No. 2, the base support may or may not be in position to do its work, depending entirely on the condition the joint ties are in. If one tie is below surface the base plate, except in the C. B. & Q. joint, is perfectly free to follow. The type therefor does not, as a rule, fill the condition.

This type takes up irregularities in the rail as well as any therefor satisfies condition No. 3. Type No. 7 does not hold the rail ends from bending upward any better than an ordinary pair of angles, again excepting the C. B. & Q. joint in which the base plate is partially effective. In the others the angles and rail ends leave the plate, to again drop under the next load. The type does not fulfill No. 4. Condition No. 5 is fulfilled perfectly by type No. 7; condition No. 6, partially, owing to complication of parts. This type offends against condition No. 7 in the same way as type No. 3. Therefore it may be said to satisfy the condition. Type No. 7 fulfills condition No. 8 perfectly. Condition No. 9 is not satisfied completely, because the parts composing the joint are free to bend independently. A stress in the base plate does not signify a stress in any other part and vice versa. This means that a load on the joint may be entirely carried by one part or at least such a proportion may be carried that the part will be unduly stressed, while another part may be practically free from stress.

With the first of the joints shown, the shoe being firmly spiked to the ties, often pulls the rail ends out of line when the bolts are tightened, which is a serious fault.

A second special criticism is that the wood crushes, allowing the shoe angle to meet the channel, when further adjustment is impossible.

To summarize all of the above types a table has been prepared, from which such conclusions may be drawn as seem best.

SUMMARY OF JOINTS AS TO THE NINE CONDITIONS.

Type.	Name.	(1) The joint must be efficient without the aid of bolts, in order to allow for expansion and contraction.	(2) The joint must have proper bearing area to prevent cutting of one part into another.	(3) The joint must take up the irregularities of rail sections.	(4) Joint must be able to resist bending in both directions, compelling rail ends to act together.	(5) The joint must not alter the running width of rail head.	(6) The joint should be simple, easy of application and renewal, and should not depend on the adjustment of one part against another.	(7) The joint should require no special arrangement of other track material.	(8) The joint should not require special form of rail end.	(9) The joint and rail ends must have same vertical rigidity as body of the rail.
1	Thomson, 100%	No*	No	Yes	No	Yes	Yes	No	Yes	No; excessive
	Bonzano, 100%	No	No	Yes	No	Yes	Yes	No	Yes	No; excessive
	Churchill	No	Partially	Yes	No	Yes	Yes	No	Yes	No; excessive
2	Fisher Triple	No	Yes	Yes	No	Yes	No	No	Yes	No
	Long Truss	No	Yes	Yes	No	Yes	No	No	Yes	No
3	Continuous	Yes	Yes	Yes	Yes	Yes	Yes	Partially	Yes	Yes
	American Standard	Yes	Yes	Yes	Yes	Yes	Yes	Partially	Yes	Yes
	Atlas	Yes	Yes	Yes	Yes	Yes	Yes	Partially	Yes	Yes
4	Pope Permanent	No	No	Yes	No	Yes	No	Yes	Yes	No
	Common Angle	No	No	Yes	No	Yes	Yes	Yes	Yes	No
5	Barschall	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
	N. Y., P. & O. Ry. Expmt	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
6	Falk Cast Weld	......	Yes	Yes	Yes	Yes	No	No	Yes	Yes
7	Weber	No	No	Yes	No	Yes	Partially	Partially	Yes	Partially
	C. & N. W. Ry. Standard	No	No	Yes	No	Yes	Partially	Partially	Yes	Partially
	C., B. & Q. R. R. Expmt.	No	No	Yes	No	Yes	Partially	Partially	Yes	Partially

* Yes, if joint fulfills condition. No, if it does not.

(To be continued.)

The Chimney of the Metropolitan Street Railway Company's Power-House, New York.*

BY WILLIAM WALLACE CHRISTIE.†

The *Railroad Gazette*, of June 8, 1900, contained an article descriptive of the large chimney at the 96th street power station of the Metropolitan Traction Company, New York. This present article contemplates testing different formulas, by the dimensions and rating of the Metropolitan chimney, and the consideration of other arrangements that would produce the same results in draft.

Outer Shell.

As the lower part of the outer shell, Fig. 1, is square and within the building, we shall only consider in this calculation a major portion of the round part. Calculating the proper diameter for the shaft to resist wind pressure at a point 253 ft. down from the top, by an old English formula,

$$y = x\sqrt{\frac{p}{3\pi k}\left(1+\frac{d}{y}\right)} = \tfrac{1}{2} \text{ diam. in feet,}$$

in which:

x = distance in feet down from top = 253,

d = outside diameter at top, in feet = 25.33,

k = strength of material per sq. ft = $\frac{144 \times 500}{10}$ = 7,200 lbs.,

p = wind pressure per sq. ft. on diam. = 50 lbs.,

we get 39 ft. as the diam., agreeing very well with the actual diameter at that section, 37 ft. 9½ in. By a

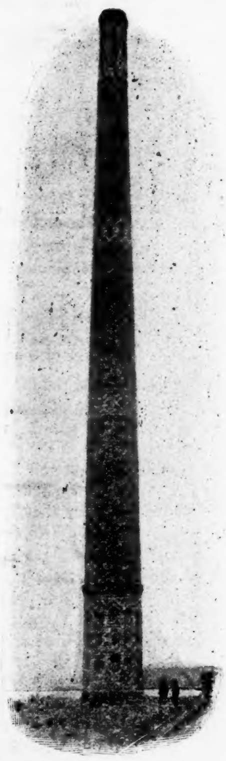


Fig. 2.—Radial-brick Chimney of Adam Weber Co., Weber, N. J.

familiar rule of thumb, the diameter should be one-tenth of the height, or 253 ÷ 10 = 25.3 ft., but as the flue is very large, 22 ft. in diam., we should naturally expect too small results by this formula.

There is some difference of opinion as shown by actual designs, as to what should be the thickness of the outer shell at the top of a chimney.

G. Lang gives for wall thickness at the top:

S = 3.937 + .05d + .0005 H = thickness in inches,

D = inside diameter of flue in inches,

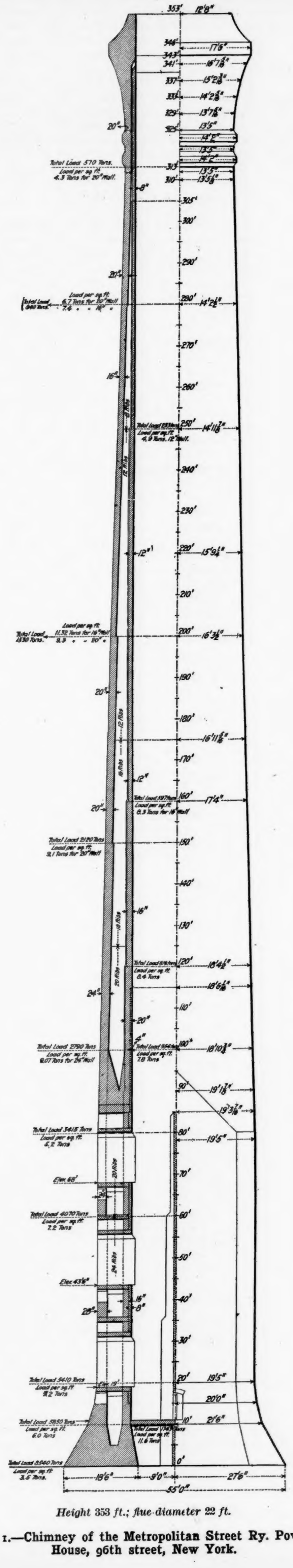
H = height of chimney in inches,

S = 3.937 + (264 × .05) + (3036 × .0005) = 18.68 in., using height same as above; that is, from 100 ft. level upward. But, if the total height is used we would get 19.28 in. as our upper wall thickness, coinciding very closely with 20 in. as used. At a lower level the thickness should be greater, but it is reduced to 16 in., and I believe that in this reduced section is where the crack appeared soon after the completion of the work. Below the 16 in. it is again increased to 20 in. It is a question whether the 16-in. wall is not bad practice as here used.

Calculations for the stability of the shaft under wind pressure of 25 lbs. per sq. ft. of diametric area show the chimney to be stable, and the eccentricity of the wind pressure exerted against the shaft is within the middle third at any section that may be considered. The outer shell being laid up with cement mortar, the highest unit load, 157 lbs. per sq. in., is not excessive. Neither is the 161 lbs. per sq. in. loading in inner shell excessive. As the joints would gape on the leeward side when the pressure on the unit area was about doubled, we might have 322 lbs. per sq. in., which is not too high for good brick work laid up properly in cement mortar, for strains of probable short duration.

*For previous paper see the *Railroad Gazette*, June 8, 1900. For general views of power station, see Jan. 12, 1900.

†Mem. Amer. Soc. M. E., Author of Chimney Design and Theory.



Height 353 ft.; flue diameter 22 ft.

Fig. 1.—Chimney of the Metropolitan Street Ry. Power House, 96th street, New York.

Capacity.

We will take the area of the flue, 22 ft. diam., as 380.13 sq. ft. and assume the horse-power of the boiler plant as 250 × 87 or 21,750 h.p. D. K. Clark says that the top diameter of the flue should be one-thirtieth of the chimney height for 600° F., temperature of the gases in the flue. In a paper recently read before the New England Cotton Manufacturers' Association, on chimney proportions, the author, H. G. Brinckerhoff, from some old rules, with his own assumptions gives what he thinks should be the diameters, heights, and horse-powers for several chimneys, and it is noticeable that the above ratio exists within a very small per cent. The writer of this article has found that where this proportion exists, or even a greater one, the best results in draft are obtained.

In the Metropolitan chimney we have 22 × 30, 660 ft., for the proper height for best results as against 353 ft., as built. Should a boiler horse-power be developed with the combustion of 3 lbs. of coal per hour, which may be accomplished, the coal burned per hour would be 65,250 lbs. This would be the coal capacity needed in the chimney. The writer's formula H. P. = 4.333 A $\sqrt{H}$, 3 lbs. of coal being burned per h.p. would give 30,932 h.p. for this chimney or H. P. = 3.25 A $\sqrt{H}$. (Page 23, Table 8, Chimney Design and Theory.) Four pounds per h.p. gives 23,164 h.p. Therefore, if our assumption of h.p. of boilers is correct, the chimney is plenty large enough for the maximum work that will be required of it.

D. K. Clark's rule gives for force of draft in inches of water $F = 353\left(.0146 - \frac{7.66}{T^1}\right)$. In this case we shall assume T^1 as 400° + 461° or 861° F.

Then F = 2.0157 in.

Another rule gives F = 0.192 H (D-d),

D = density of outside air = .076374 at 60° F.,

d = density of hot gas in chimney = .04859 at 400° F.,

F = 0.192 × 353 (.076374 — .04859) = 1.8828 in.

The draft may not be as good as either figure, if the gases enter the chimney at 400° F., as the temperature is lower at the top, than at the bottom, the formula considering it the same for the whole height.

To the writer, one of the most unfortunate features of the 96th street station, in which the boiler and engine outfit can be operated in units, is that it has but one chimney. In case of an accident to it, or the large flues after they come together at the chimney, the entire plant must be shut down. Again the entire boiler plant will, in all probability, never be in operation at any one time, the horse-power furnished to an electric railway being continually changing, and a maximum will be used but 3 or 4 hours per day, for all of which a single chimney, planned for the maximum duty, is poorly adapted. There is therefore, an unevenness of draft, which might have been overcome by several methods, the first of which in utility, cost, and consequently in appearance, from the standpoint of the engineer, is chimneys in multiple; that is, one chimney to one or more boilers, or section of the plant. As the boilers are arranged in 3 tiers, 2 sets on each, we should consider 6 chimneys or 12 chimneys, or in fact any multiple of 6, to one's liking, as the proper number. If we chose 12, we should have 23164 ÷ 12, or in round numbers, 2,000 h.p. each; from table 8, page 23, Chimney Design and Theory, by the writer, we should have a chimney say 7¼ ft. in diam. x 225 ft. high. Either in steel, brick, or radial brick, these would be cheaper and more effective than the single chimney. In event of the entire plant not being in operation we could still have a perfect draft for those boilers in operation. The boilers cut out could all be taken from one chimney, then from another, and so on, leaving each chimney with a steady load as long as possible.

The ordinary two-shell chimney of red brick, especially for such a large flue diameter, gives a necessarily high total weight of material, and consequently high unit load on the foundation soil. This can be reduced by the use of a better brick, one stronger and less porous in its make-up. Such material is now supplied in this country by two firms, and is known as radial brick construction. This method of construction is in use quite extensively in Germany and other European countries, and several chimneys have been built here, the first being for Adam Weber Co., Weber, N. J., Fig. 2. Radial perforated bricks made possible the high and slender chimney at the Imperial Foundry near Freiburg, Saxony, 453 ft. high, with a flue 15 ft. 9 in. in diam. The cost of this type of construction is about 20 per cent. less than that of the double-shell red brick chimney. A chimney of this character for the Metropolitan station would not only have saved the driving of many piles, but also made the unit load at the bottom of foundation very much less. Because of the greater strength of the material, the diameter at the base could have been decreased, less land occupied, or more room given for arranging the flues. Other types of chimneys, which we have not considered, are the steel chimney lined or unlined, guyed or self-supporting, set on foundation at grade or on masonry pedestal above the ground, all or any of which are cheaper than the double-shell brick chimney.

Still other means of obtaining the necessary draft are by some one of the mechanical methods. They can be installed in units of one, or any other number, and be provided with a short chimney of steel or other material. As to the large saving claimed, the writer believes that with the same fuel, same grates and same weather, there is no better result in evaporation per pound of combustible with forced draft than can be obtained with natural draft.

Recently, in talking over this subject with one of the

leading consulting engineers in power installation, he said that in short-run tests he found some economy in forced draft, but in 24-hour runs he found an actual loss in the use of blowers. Not being able to get any definite information as to the cost of the Metropolitan chimney I have estimated it as follows:

1,300 piles driven, at $10	= $ 13,000
Portland cement concrete, 5,400 cu. yds., at $6	= 32,400
3,400 thousand brick, fire-brick, etc., at $20 per 1,000 for red brick	= 68,000
	$113,400

Call it in round numbers $120,000, and we will not be far astray; 120,000 ÷ 23,164 gives us $5.18 per h.p. (W. W. C's Rating) as its cost. The following list is one which has been made up from actual costs, and may prove interesting in this connection:

Description.	†† Page.	H.-P., W. W. C.'s Rating.	Cost, Dollars. Total	Per Rated Horse-P.	Remarks.
Radial brick, Circ....	86	13,484	40,000	3.00	Foreign.
Red brick, Circ.......	91	4,040	16,000	4.0	
" " "	92	6,000	18,500	3 00	
" " Rect......	93	450	2,192	4 87	
" " Hex..	106	12,211	55,000	4.50	
" " Circ......	106	4,859	10,000	2.06	Single shell, firebrick lining half height.
" " "	118	2,925	15,000	5.13	
" " "	118	5,772	40,000	6.93	
" " "	118	6,300	18,500	3.00	
" " "	119	6,000	25,000	4.25	
" " "	...	1,100	4,950	4.50	
" " Rect......	...	517	1,900	3.80	
Steel, self-supporting	58	2,400	10,000	4.15	Lined throughout.
" "	60	2,350	8,000	3.40	Half-lined, price without foundation.
" "	...	240	700	2.91	Unlined.
" guyed..........	...	240	400	1.66	"

††"Page" refers to pages in Chimney Design and Theory, by W. W. Christie, where particulars are given.

Based upon figures given in the table, 12 chimneys of 2,000 h.p. each, if built of red brick, would cost about $8,500 each, 12, $102,000; of steel, self-supporting, full lined, about $8,300 each, 12, $99,600; of steel, self-supporting, half lined, about $7,800 each, 12, $93,600; of steel, self-supporting, unlined, about $5,820 each, 12, $69,840; of steel, guyed, about $4,000 each, 12, $48,000.

To substitute forced draft apparatus for the large chimney, or chimneys in multiple, there could be used forced or induced draft, or steam blowers. In this connection an 80-in. centrifugal blower, 48 in. wheel, 4 x 3 in. double engine, blower and engine on beam platform, was erected in New England in 1899, connected with a 48-in. diam. chimney of No. 12 steel, 22 ft. high, 10 ft. of it above the roof, 1 in. thick cast base plate. The total cost for apparatus, frame work, and mason work was $856. The boilers used in the plant, in connection with the blower, were horizontal tubular, one 80-in. diam. x 17½ ft.; two 72 in. diam. x 17½ ft. In the same year a self-supporting steel chimney, unlined, 3½ ft. diam. x 105 ft. high, was erected, with foundations and flue connections, at a cost of $1,013. The chimney was made of 3-16, ¼ and ⅜-in. steel. The blower outfit works satisfactorily in the part having two boilers with a total of 75 sq. ft. of grate. The chimney gives a very satisfactory draught for 93 sq. ft. of grate surface, and if it had been made 48 in. diam., as in the blower outfit mentioned, and been guyed with wire rope, with a light foundation, $800 would easily have met the expense. The cost of a double fan outfit, with a short chimney for 1,600 boiler h.p. is given as $3,500, or $2.19 per h.p. Then the twelve 2,000 h.p. outfits would cost $4,830 each, or $52,560. Taking the cost of fuel for 24-hour days, one year's coal would cost about $24 × 23,164 = $555,936. To create mechanical draft for 23,164 h.p. would cost between 2 and 5 per cent. of the above, or $11,120 to $27,796 per year. It has been given as low as .5 of 1 per cent. The interest on the $120,000 chimney at 4 per cent. would be only $4,800, leaving a decided balance in favor of the chimney. When the use of chimneys in multiple is considered there would be a still greater saving.

*For a good steam plant it is fair to assume the following as average fixed charges for mechanical draft apparatus:

Interest	5 per cent.
Depreciation	4½ per cent.
Insurance and taxes	1½ per cent.
	11 per cent.

For a chimney:

Interest	5 per cent.
Depreciation and repairs	1½ per cent.
Insurance and taxes	1½ per cent.
	8 per cent.

Then the operating expenses for a mechanical draft apparatus for the plant are say $12,000, to which must be added the fixed charges, 11 per cent. of cost of outfit, or $5,781, making a total of $17,781, which must be compared with 8 per cent. of chimney cost, or $9,600.

Should a cheaper grade of fuel be used there may be an advantage in using mechanical draft. A reduction of over $6,500 per year has been made in actual practice in the case of a boiler plant of 1,000 h.p., by the introduction of mechanical draft, and the burning of buckwheat and yard screenings with a slight mixture of Cumberland coal.

*The influence of Mech. Draft upon the ult. Eff. of St. Boilers.—Walter B. Snow.

From published tests of steam blowers it is learned that they use from 7.4 to 8.78 per cent. of the steam made by the boilers. Eight per cent of the value of coal used for 24,000 h.p., or $44,474, should be placed in comparison with the operating expenses, $12,000 for mechanical draft, and nothing for the brick chimney, to show the expensiveness of this method.

New York city has the largest chimney in America. It cannot be said, however, that it will be the means of giving any larger returns to investors than would be given by a number of smaller ones, properly designed and located. The writer is a firm believer in the efficiency of chimneys in multiple.

Cast Iron Car Wheels.*

The Interstate Commerce Commission, in its report of June 30, 1899, gives the number of cars and locomotives in use in the United States, as follows: Locomotives, 36,234; coaches, 33,595, and freight cars, 1,248,826. Taking eight wheels to each freight car, and allowing 50 per cent. of the wheels under coaches and locomotives for steel tired and designs other than the cast-iron wheel, there are in use at the present time 10,269,924 cast-iron wheels. Taking into consideration the small amount of damage done, due to the failure of the cast-iron wheel, it would almost seem that the manufacture of the cast-iron wheel has been brought down to a science. Undoubtedly a persistency in the use of the drop and thermal test has been productive in bringing about these favorable results. A prominent wheel manufacturer made the remark recently that close inspection and tests had been leading factors in lifting him out of a rut in which he would doubtless have remained had it not been for inspection and tests.

A number of manufacturers of cast-iron wheels have made quite a protest against the thermal test, assuming that, in making wheels to meet this test they would do so at a sacrifice of the wearing qualities. While the adoption of the thermal test does not date back far enough to give correct data on this subject, we think there is no reason for this anxiety on the part of the manufacturer regarding loss in wear in wheels made to stand thermal test specifications, provided the thermal test specified is a reasonable one. For the fact is conceded that, no matter what may be done with a car wheel, some extraordinary conditions may arise which will break it.

The thermal test specifications as required by the Chicago, Burlington & Quincy are as follows:

"The test wheel must be laid flange down in the sand and a channel way 1⅛ in. wide and 4 in. deep must be moulded with green sand around the wheel. The clean tread of the wheel must form one side of the channelway and the clear flange must form the bottom. (It will be noted that the width of the channelway is equal to the height of the flange, namely, 1⅛ in.) The channelway must be filled to the top with molten cast-iron, which must be poured with two ladles directly into the channelway. The molten iron must be taken from the big ladle directly after a tap for pouring wheels has been drawn from the cupola. The channelway must be filled with the molten iron in no greater time than one minute after the iron has been taken from the big ladle. No puddling or cooling of the iron will be allowed. If the molten iron boils in the ladles, they must be refilled until all indications of boiling cease before the channelway is filled. The time when the pouring ceases must be noted, and two minutes later an examination must be made, and if the wheel is found cracked in the plates or through the tread, the wheels represented by the test wheel will be rejected. Wheels that are wet or have been exposed to the frost may be warmed sufficiently to dry or remove

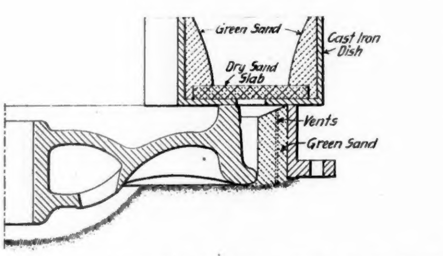


Fig. 1.—Method of Pouring for Heat Test, C. B. & Q. R. R.

frost before testing. Fig. 1 shows the method of pouring the thermal test.

In addition to the above, the following recommendation is made, namely: "That at the option of the manufacturer, if the test wheel fails under this thermal test, a second wheel showing the next lower shrinkage size, to the wheel which failed and cast on the same date as the failed wheel, may be selected by the inspector and used for test. If the second wheel stands the thermal test, all wheels of the same and all lower shrinkage sizes may be accepted, while the wheels of the same and higher shrinkage as the failed wheel must be rejected."

Wheels tested according to the above thermal test specifications, and in conjunction with the Barr drop test, will assure the railroads the greatest degree of safety in using cast-iron wheels. The above recommendations are made for the following reasons, namely: The shrinkage allowed on a cast-iron wheel is ½ in., ¼ in. above and ¼ in. below the mean circumference, divided in four tape sizes of ⅛ in. The tape No. 1, or highest shrinkage, are the weaker wheels, conditions being normal. The inspector being aware of this almost invariably selects the tape No. 1, or highest shrinkage number, for test. He is justified in so doing, for the first thing to consider in the inspection of wheels is the point of safety. If the tape No. 1 fails when in the thermal test, reject them, and allow the inspector to select one of the tape No. 2, or next lower shrinkage number, and if the second wheel fails, reject all of the wheels represented; providing, however, the second wheel stands the thermal test, it seems hardly fair to the manufacturer to condemn the second and lower shrinkage numbers, the inspector being satisfied by test on the second tape sizes that they are sufficiently strong and are hard enough to give the wear.

*From a paper by Mr. G. W. Beebe, Wheel Inspector, Chicago, Burlington & Quincy, presented before the Western Railway Club.

An inspector should make a study of iron, so that he can readily designate at a glance whether the first wheel failing could be attributed to bad iron or abnormal conditions in the pitting or handling of the failed wheel. A wheel can be made of a hard, close grain iron that will stand the drop test or concussion in service, but if subjected to a severe and continued brake application is liable, as a boy says, "to go up in smoke." A gritty, hard chill will not make the mileage that a tough chilled wheel will. A gritty chill will shell out quicker than a tough one, because it will not stand the heat that is caused by severe brake application. Good white iron is tough, as well as being hard enough. There is a great difference in the quality of white iron as there is in gray iron; good white iron has a large proportion of combined carbon; bad white iron has a large proportion of sulphur. I believe the steel tired wheel proves that the toughness gives the wear. I have not seen or heard of a steel-tired wheel shelling out. I have heard some railroad men say that when they can cut the chill of a wheel with a chisel, that the wheel will not make good mileage. If this is the case, the steel wheel could not make the mileage that is claimed for it, because the steel-tired wheel is turned before being put into service, and it certainly must be soft in order that it can be turned. These hard, gritty, wheels will fail in the thermal test, or by severe brake application.

The following table shows a comparative record of tests made by the writer under the Barr drop, in 1893, as against tests made in 1900:

Test of Wheels Made in 1893—Barr Drop.

Wheel No. 000, tape 2—weight, 585 pounds; diameter, 33 ins—
Number of blows to break....... 14
Wheel No. 000, tape 2—weight, 585 pounds; diameter, 33 ins—
Number of blows to break...... 21
Wheel No. 000, tape 2—weight, 585 pounds; diameter, 33 ins—
Number of blows to break....... 37
Gen. ave. of blows to break.... 24

Test of Wheels Made in 1900—Barr Drop.

Wheel No. 000, tape 2—weight, 585 pounds; diameter, 33 ins—
Number of blows to break......175
Wheel No. 000, tape 2—weight, 585 pounds; diameter, 33 ins—
Number of blows to break.......227
Wheel No. 000, tape 2—weight, 585 pounds; diameter, 33 ins—
Number of blows to break....... 93
Gen. ave. of blows to break....165

The above wheels tested were made by the same manufacturer, and these tests certainly show a marked improvement in the strength of wheels made in 1900, as compared with those made seven years ago. Regarding the depth of chill, it should not exceed ¾ in. in the throat, or 15-16 in. in the center of the tread. The minimum should not be less than ¼ in. in the throat, or ⅜ in. in the center of the tread. Assuming that we have the maximum depth of chill, 15-16 in., we get the blending of the white iron through the entire tread and begin to crowd the danger line, and gain nothing thereby. A highly chilled wheel will shell out and become comby by sliding more readily than a medium chilled wheel. In breaking up 300 defective wheels that were removed on account of shelled spots, 95 per cent. showed a high chill.

The responsibility of the wheel manufacturer is frequently a disputed question, but both parties agree in the majority of cases, excepting as to the difference in comby and worn flanged wheels. There should be no disputed question as to the comby wheel, as it is a very easy matter to determine whether this defect was caused by a severe brake application or faulty metal. The matter of fitting wheels, especially at contract shops, does not receive the careful attention in many cases that it should, and many instances can be given showing gross carelessness in pressing the wheels on the axles, and also in imperfect boring and mating of the wheels. While visiting a contract shop recently, I noticed them mounting wheels at as high a pressure as 85 and 90 tons. Pressing wheels on axles at as high a pressure as 85 tons will produce strains in the wheel that are very likely to develop and cause trouble after the wheel is placed in service.

It seems to the writer that some of the following recommendations, followed up closely, would lead to better results in the use of the cast-iron wheel:

First. That more attention be given to the taping and mating of wheels in nearly all contract shops, and in some railroad shops the tape sizes that are applied to the wheels where they are manufactured are used without any check. All wheels should be re-taped where they are mounted.

Second. All axles should be centered and a gage used similar to the one shown in Fig. 2. The fillet in the throat

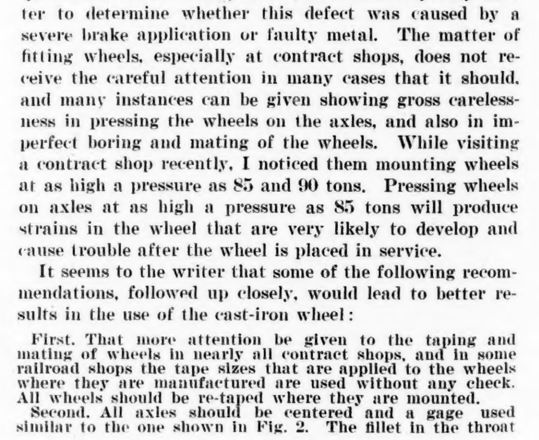


Fig. 2.—Gage for Mounting Wheels.

of the wheel, see letter "A" on Fig. 2, and the apex or separating line on the flange, see letter "B" on Fig. 2, are the only correct points to work from, in pressing on wheels. Care should be taken to have letters "A" and "B" on the wheel form a conjunction with letter "C" on the axle. If

we press one wheel a little too far on the axle and its mate not quite far enough, we mismate them by forcing one wheel to run on the high part of the tread close to the flange, while its mate runs on the low part of the tread close to the rim, and in a short time we will have a worn flange wheel on one end of the axle and a worn tread on the opposite.

Third. That the practice, as followed in some shops, of only taking one cut in boring out wheels be discontinued, as it is not practical to get a good wheel fit without taking a finishing cut. The New York Central Railroad, I believe, sends a practical man to look after the turning up of axles and the fitting and mating of wheels at contract shops where they have cars under construction. It seems to the writer that this is a very good practice, and one that all railroad companies could profit by.

Fourth. That, where practical, wheels made by the same manufacturer should be mated on the same axle, as a very slight variation in the turning up of the chill will make quite a difference in the shrinkage number of the wheel, and by mating two different makes of wheels we are quite likely to get a hard and soft wheel on the same axle.

The design of a pattern is one of the essential factors in the manufacture of the cast wheel, other than the thickness of flange, shape of hub and tread. The designing of the pattern should be left to the discretion of the manufacturer. A large percentage of wheels that fail in the brackets can be ascribed to a poorly designed pattern; too light brackets will crack because they cool more rapidly than the plate of the wheel, which would cause a strain on them; too heavy a bracket will throw the strain on the plates, causing the plates to crack.

For those who are not familiar with the drop test used in testing wheels, Fig. 3 gives an illustration of the Barr drop, and Fig. 4 the M. C. B. drop. It will be noted that the hammer of the Barr drop strikes the single plate

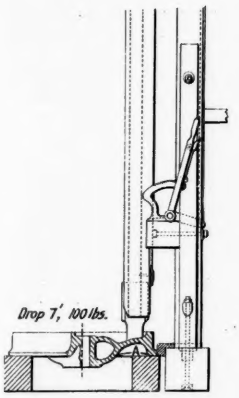


Fig. 3.—Barr Drop Testing Machine.

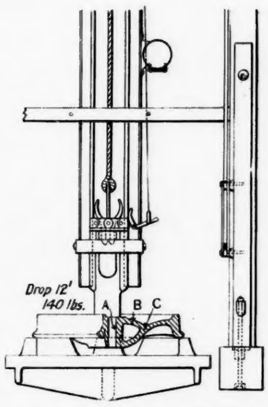


Fig. 4.—M. C. B. Drop Testing Machine.

of the wheel, see letter "A" on Fig. 3. The hammer of the M. C. B. drop strikes the hub of the wheel, see letter "A" on Fig. 4. A wheel rarely fails in service in the hub, double plates, or at the intersection of the plates, see letters "A," "B" and "C" on Fig. 4. If a crack does occur at these points it does not necessarily cause the wheel to become dangerous. If a crack occurs in the single plate, see letter "A" on Fig. 3, we then have a dangerous wheel and it will not run long before giving way entirely. It will be noted that wheels tested under the M. C. B. drop are placed flange downward on an anvil block, having three supports for the flange of the wheel to rest upon. The hammer strikes the central part or hub and the whole of the wheel resists the concussion; while the wheels tested under the Barr drop are placed flange downward on a flat surface anvil block, and the wheel receives the concussion at one point only. The Chicago, Burlington & Quincy specifications require wheels tested under the Barr drop to stand fifty blows without breaking out a piece. The Pennsylvania Railroad specifications, I believe, require wheels tested to stand twelve blows under the M. C. B. drop without breaking out a piece. It would seem fair to assume that the Barr drop would find the weak or dangerous part of the wheel more readily than the M. C. B. drop.

The treatment and handling of the hot wheel has nearly as much to do with the strength as does the material used. Cold iron will produce seams in the tread, and internal strains, because the molten iron sets in the mold as fast as it is poured. Hot iron with slow and uneven pouring, produces sweat in the throat, uneven chill and internal strains; delay in getting the hot wheel into the pit after being shaken out of the mold, will also produce strains in the wheel by uneven contraction. To overcome these undesirable results it is necessary to have hot iron and fast pouring. The maximum limit of time in pouring up a 33-in. wheel should not exceed 12 seconds. Wheels must be got into the annealing pits expeditiously after being shaken out of the mold. The annealing pits should also be covered properly. The following table gives the analysis of a number of wheels tested under the Barr drop and in the thermal test.

	Wheels that failed in thermal test.		Wheels that stood thermal test.		Wheels that failed under 50 blows, Barr drop.		Wheels that stood 50 blows and over, Barr drop.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Total carbon........	3.91	3.63	3.90	3.38	3.87	3.42	3 93	3.49
Graphitic carbon ..	3.02	2.92	2.98	2.71	3.19	2 90	3.02	2.90
Combined Carbon..	.89	.71	.92	.67	.68	.52	.91	.59
Sulphur............	.090	.042	.10	.080	.080	.020	.070	.05
Manganese..........	.60	.49	.58	.48	.62	.40	.72	.47
Silicon............	.82	.50	.91	.50	.97	.67	1.10	.68
Phosphorus.........	.48	.39	.52	.26	.58	.30	.53	.28

A part of the wheels failing under these tests cannot be ascribed to the composition.

The Elliott Cresson Medal for the Pencoyd Works.

The Franklin Institute of the State of Pennsylvania has awarded to the Pencoyd Iron Works the Elliott Cresson gold medal for the exhibit made by those works at the National Export Exposition in Philadelphia in 1899. The matter was referred as usual to the Committee on Science and the Arts and the recommendation of that Committee has been adopted by the Institute. What follows is from the report of the Committee.

The exhibit consisted of a very creditable and interesting display of steel structural shapes, girders, bridge materials, etc., and a full-sized model of one of the expansion ends of the Delaware River bridge, with its roller bearings. Apart from the high quality of the articles exhibited and the exceedingly interesting display made, the attention of your sub-committee was called to some special features in the construction and erection of several important bridges recently built by the company, namely, the Niagara and Clifton Bridge, at Niagara Falls, the Atbara River Bridge, over the Atbara River, for the British Government, and the Delaware River Bridge of the Pennsylvania Railroad Co., near Philadelphia.

In the case of the Niagara Bridge, the conditions were very difficult and exacting, first, the center or main span over the river is of unusual length (more than 200 ft. longer than any arch structure ever before attempted), and second, the great depth of the river and the rapidity of the current rendered falseworks entirely impracticable.

[It is not necessary for us to print here the Committee's description of the Niagara Bridge, that having been very fully described in past issues of the *Railroad Gazette*.]

The method was as follows, quoting from a paper submitted by the company.

"The deflections were carefully figured and the toggles for the final adjustment set so that, according to figures, the lower center panel point ought to have come exact at the normal temperature. It was then expected to close up at this lower panel point with a pin, so that after the anchorage was removed the structure carried itself as a three-hinged arch. In this condition the two upper center panels were figured to be shortened 2¼ in. from the theoretical length. These two chord panels were therefore shortened 3 in. each and the so-obtained opening of 6 in. was expected to be reduced in this three-hinged arch condition to 3¾ in. By an application of a compressive strain of 370,000 lbs. in these middle panels (which stress was actually applied by hydraulic jacks), the original opening of 6 in. was supposed to be obtained and the arch then to be closed as a two-hinged arch. The proper corrections for the variations in temperature of course had been figured. The lower panel point was closed a little below normal temperature with ¼ in. opening. At a normal temperature in the three-hinged condition 3¾ in. opening was obtained, which opening, by the application of about 370,000 lbs. was increased to 6 in. By thus weighing the strain in the upper chord of the center of this arch, all undesirable strains due to cantilever erection, are eliminated from the structure, and the condition of the strains in the structure made to correspond with the figures."

After this work was finished it was discovered that a German Engineer had conceived and adopted the same method of closing up a bridge arch (but entirely unknown to the Pencoyd Company's engineers) another example of the simultaneous invention of an important principle by people widely separated and unknown to each other.

To show the wonderful degree of accuracy attained in the preparation of the materials: in the measurements at the river in locating the abutments, and in the erection of charge of the work, reporting to his company the success of the plans for closing up the arches.

"When the last bottom chords were put in place there was just 1¼ in. clearance between the face surface, or ¼ in. clearance for the pin. The temperature was a little below 60 deg. This shows that our measurements and the shop work were practically exact. The alignment and the respective elevations of the two halves at the center was so nearly right that they were pulled into line with a steamboat ratchet. The toggles were not used at all except to slack off after the center pin was driven. The work all came together in a most gratifying manner."

Atbara River Bridge.

"Bridge consists of seven spans 150 ft. each, which, due to local conditions, had to be erected without falsework.

"One span was put up temporarily on shore and the first river span hung out from this and erected by a steel traveler running on top chord and by anchoring the first span down with about 60,000 lbs. of steel rails. Then, after the removal of the temporary span, the second river span was erected in the same way, using the first one as an anchorage, etc.

"To overcome the deflections of the spans and the effects of the camber on the position of the end which had to be coupled up over the far pier, the ends were raised 2 ft. by shortening the coupling bars over the pier carrying the anchorage span and the cantilever span. The end shoes were then figured to land 4½ in. above the piers. The actual distance measured varied from 4 to 5 in.

"While single spans have previously been erected this way by building out cantilever from both shores and closing in the middle, it had never before been attempted to erect a large number of spans this way by hanging each span out as a cantilever for its full length."

Delaware River Bridge—Pennsylvania Railroad Co.

"Approaches, 2,468 ft. long, three fixed spans of 533 ft. c.-c. end pins, one draw span of 323 ft. c.-c. end pins, all double track.

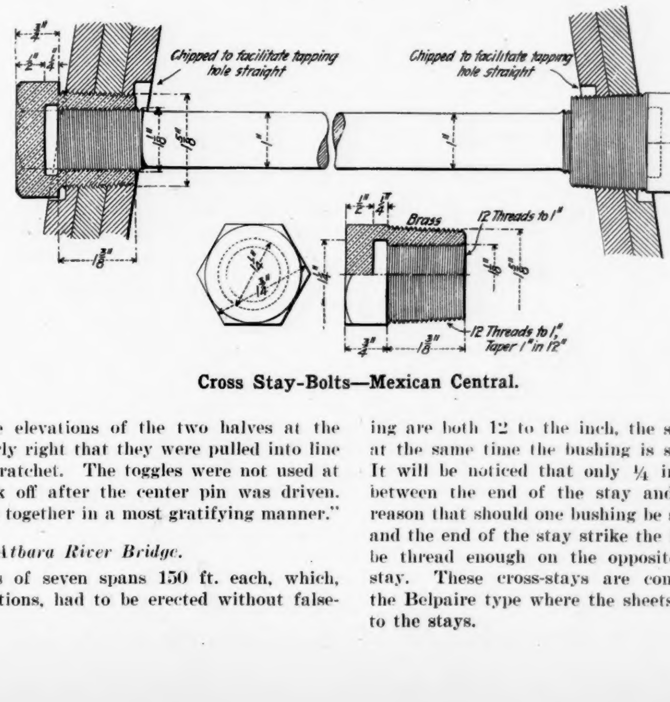
"The fixed spans were so designed that no eye-bar was tapered more than 1-20 in. per ft. and that the eye-bars in the same panel have practically the same taper; also that all members are absolutely straight when they get their maximum strain. This reduces the secondary bending strain, due to the use of a secondary system, of the members considerably (in the end posts over 33 per cent.). The roller end rests on seven cast steel segmental rollers 18 in. diam. which are held in position by a gear tooth at each end of the middle roller. The four webs of the chords and end posts are prevented from shifting sideways by vertical diaphragms near each pin hole. The floor was put in place after the trusses were swung entirely free. All stringers were kept about 1-16 in. long and the connection angles had a 6-in. leg against the floor beam with rivets as far as possible away from the stringers. Through this arrangement the pull on the connection of the stringers to the floor beam due to the stretch of the lower chord of the main span (about 3 in.) was overcome.

"The draw span was entirely center bearing. This is the heaviest draw where the center bearing construction has been used and has a great many novel features in the machinery. Entirely new is the counterbalanced latch, which is provided with a wheel at the lower end, and the catch for which is so arranged that if the draw gets to the closing point with too fast a speed, the latch will jump over the opening without jarring the bridge."

As an illustration of the remarkable progress made in recent years in the field of bridge and other structural engineering, and the advanced position attained by the Pencoyd Iron Works in this important field, as attested by the great works above described, especially the Niagara Falls and Clifton Bridge and the Delaware River Bridge, the Franklin Institute awards to the Pencoyd Iron Works the Elliott Cresson (Gold) Medal.

Cross-Stays—Mexican Central Engines.

The six consolidation locomotives which the International Power Co., of Providence, R. I., recently built for the Mexican Central Railway have cross-stays, as shown in the accompanying drawing, the design of which is somewhat simpler than the cross-stays illustrated in the *Railroad Gazette* of Dec. 29, 1899. In this later design the nut and washer on the end of the cross-stay are done away with, the brass bushing having a solid outer end, and being threaded to receive the end of the stay. In putting in this stay, it is placed in the boiler, and the bushings on either end are screwed in simultaneously. As the thread on the stay and that on the outside of the bushing are both 12 to the inch, the stay enters the bushing at the same time the bushing is screwed into the boiler. It will be noticed that only ¼ in. clearance is allowed between the end of the stay and the bushing, for the reason that should one bushing be started before the other and the end of the stay strike the bushing, there will still be thread enough on the opposite bushing to hold the stay. These cross-stays are convenient on boilers of the Belpaire type where the sheets are not perpendicular to the stays.



Cross Stay-Bolts—Mexican Central.

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CONTRIBUTIONS—Subscribers and others will materially assist us in making our news accurate and complete if they will send us early information of events which take place under their observation, such as changes in railroad officers, organizations and changes of companies in their management, particulars as to the business of the letting, progress and completion of contracts for new works or important improvements of old ones, experiments in the construction of roads and machinery and railroads, and suggestions as to its improvement. Discussion of subjects pertaining to ALL DEPARTMENTS *of railroad business by men practically acquainted with them are especially desired. Officers will oblige us by forwarding early copies of notices of meetings, elections, appointments, and especially annual reports, some notice of all of which will be published.*

ADVERTISEMENTS—We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay, EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and these only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers, can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially either for money or in consideration of advertising patronage.*

Railroad gross earnings for September continue to show increase, though the total increase and rate per cent. are much smaller than for recent months and the number of railroads reporting decreases is considerably augmented. *The Chronicle's* figures cover 107 roads aggregating 101,068 miles, against 97,678 miles a year ago. Their gross earnings were $60,761,204, which was an increase of $1,316,472, or only 2.21 per cent. This is in comparison with $6,081,159, or 11.08 per cent. increase in 1899, $2,790,805, or 6.04 per cent. in 1898, and $6,385,823, or 14.14 per cent. gain in 1897. Decreases are reported on 36 of the roads and 14 of these in amounts over $30,000. Among these are the Great Northern system with a loss of $236,422, the Northern Pacific $173,475, the Chicago, Milwaukee & St. Paul $150,940, and the Minneapolis, St. Paul & Sault Ste. Marie $124,984. The Illinois Central leads the list of roads reporting gains with $300,668. The Chesapeake & Ohio reports gains of $226,917, the Baltimore & Ohio $192,308, the Choctaw, Oklahoma & Gulf $151,000, the Mexican Central $146,055, the Norfolk & Western $140,602, the New York Central $137,680, and the Missouri Pacific $137,336. A number of causes have contributed to the falling off, chief of which were the lessened activities in cotton and grain movements and the floods in Texas. The anthracite coal strike began Sept. 17 and has had its effect. But none of the companies are included in the statement. Bituminous coal roads like the Chesapeake & Ohio and the Norfolk & Western exhibit gains in earnings because of the increased demand for soft coal. The failure of the spring wheat crop is having some effect on certain roads. There was a slight increase to be sure in the wheat receipts for four weeks at 10 western centers, from 29,746,400 bushels a year ago to 29,861,105 bushels this year, but this gain has been in the winter wheat. At Minneapolis the deliveries were 7,400,100 bushels this year, against 9,600,140 bushels a year ago, and at Duluth there were only 2,827,043 bushels delivered this year, against 10,614,282 bushels last year. There has been a marked falling off also in corn receipts, from 26,244,602 bushels a year ago to 17,524,363 bushels this year. The decreased cotton movement is shown by the receipts at Southern outports of 618,290 bales this year against 789,048 bales in September, 1899. The overland shipments were but 32,502 bales, against 79,651 bales in 1899. Of the groups of roads only one, the Northwestern and North Pacific, shows a falling off. These 12 roads report gross earnings for September, 1900, of $14,954,535, against $16,122,116 a year ago.

The Preservation of Railroad Ties.

The best document on preserving ties that has been printed (in English at least) since the famous report to the American Society of Civil Engineers in 1885 appears in the September issue of the Proceedings of that Society, and it is by one of the original committee. Of course, we mean Mr. Chanute and speak of a paper by him which is scheduled for presentation to the Society at the regular meeting of Oct. 17. No man in America has studied this complicated subject with more assiduity and ability, and his presentation of the state of the art to-day is so clear and compact that we feel justified in giving much space to extracts from the paper.

Mr. Chanute finds that 90 per cent. of the ties used in Great Britain are preserved, and we infer that quite as large a proportion of those used in Germany and in France are also treated. The life of ties in England seems to run all the way from eight to thirty years and the destruction is generally from wear. We judge that the railroad reporting a life as low as eight years, namely, the North London, finds rapid destruction under very intense traffic, the lines of that company being, we should suppose, quite as much used as any other rails in Great Britain. In France again the life is reported all the way from eight to thirty years, and there, singularly, decay appears to be the most common cause of destruction. In Germany the life expected is 24 to 28 years.

In English practice from 22 to 30 lbs. of tar-oil is injected per tie. In France the quantity is running up, reaching as much as 60 lbs. on the Eastern and the Paris, Lyons & Mediterranean. In Germany also the quantity of tar-oil injected is considerably greater than in England.

Naturally, the cost per tie varies with the treatment. In England it ranges from 12 to 30 cents, in France it runs up to 64 cents for beech ties and in Germany it ranges from 22 to 57 cents, according to the grade of treatment.

Mr. Chanute estimates that at present prices it would cost us in the United States 45 cents a tie to preserve according to good English practice, giving 15 or 16 years' life, and it would cost us 85 cents according to the French and German practice with 27 to 30 years' life. He concludes that it would not be economical at present prices of ties to treat them so thoroughly, but that we must go on using untreated ties with shorter life in track, or we must use inferior and cheaper methods of preservation. He thinks that his zinc-tannin process is better than Burnettizing, but he thinks now after his latest studies that the zinc-creosote process is better than zinc-tannin. As to the probable life under different treatments his summing up is this: "With the equivalent of one-half pound of dry zinc chloride to the cubic foot, straight Burnettizing makes ties last 10 to 12 years in the track with ordinary exposure; while perhaps half that quantity will produce the same result in the more arid regions of the United States; the new zinc-tannin process will impart to them a life of 12 or 14 years and the zinc-creosote process may extend this to 14 or 16 years. It cannot, however, be too strongly insisted upon that the work must be well and skilfully done, for otherwise the results are sure to be disappointing."

Some Data of Fast Trains.

At the sixth session of the International Railway Congress, just held in Paris, question XII. was on locomotives for trains run at very high speed. The question as formulated (in the English translation) is "progress realized in the construction of *steep* locomotives attaining very high speeds (56 miles per hour and upwards), and especially in the motive power of fast trains heavily laden running over lines of steep gradients. Use of the compound engine." As we have not at hand the original French version of the question we can only conjecture that somebody has substituted the word "steep" for "steam." However, that is a matter of no importance.

The reporter on this question for the United States was Mr. J. R. Slack, Assistant Superintendent of Motive Power of the Delaware & Hudson, and his report is a comprehensive and interesting document. However, as often happens in such cases, he was unable to get replies from many railroads, only 22 companies being represented. The tabulated data show the following classes of trains: Light and fast trains on light grades, heavy and fast trains on light grades, fast trains on heavy grades, all of these being for 1899; also fast and light and fast and heavy trains, on light grades, in 1889. Unfortunately, the 1889 examples are very few, covering in fact only nine trains. Furthermore, it was thought best to include the fastest trains on each road reporting, although in some cases they did not fall strictly in the class of high speed trains.

The tables show the journey speed, also the speed deducting stops, the distance, the number of stops, the rate and length of grade, the run made without change of engine, weight of train and number of cars, maximum schedule speed and maximum speed reached; type of engine, with weights and very full particulars of boilers, valves, cylinders, journals, fuel used, fuel and water consumption, tractive power, piston speed, etc. Convenient diagrams are appended showing at a glance types and dimensions of engines.

(1) In the class of light and fast trains the best journey speed is found on the Philadelphia & Reading between Philadelphia and Jersey City. There a run of 90.2 miles, with seven stops, is made at 58.2 miles an hour, or 62.2 excluding stops. The maximum schedule speed of this train is 75 miles an hour and the maximum actually reached is not given. The weight of this train behind the tender is 100 net tons and the engine credited with doing the service is put down as a "bicycle" engine, carrying 50,500 lbs. on the drivers. This, of course, is the well known "single-driver" Baldwin engine—probably the term bicycle crept in after the report left the author's hands. The next best journey speed is on the New York Central, namely, 53.9 miles an hour for 444.6 miles with four stops. Deducting stops the speed is 54.3 miles an hour. Obviously, this is the Empire State Express, which train is scheduled to reach a rate of 68.5 miles an hour, which is also given as the maximum actual speed. This is not quite true, for the train must frequently go considerably faster than that; in fact we know that it does. However, Mr. Slack is not warranted in going beyond the official returns made to him. This train is reported as weighing 212 net tons behind the tender. The Chicago, Burlington & Quincy reports the next best train, namely, 53.3 miles an hour for 206 miles with three stops. Deducting stops the train makes 58 miles an hour from terminus to terminus and the maximum schedule speed is 90 miles an hour, which is also noted as the maximum actual speed. This train weighs 132 net tons behind the tender and carries four cars. This road has another train on the same run, between Chicago and Burlington, which makes five stops with a journey speed of 47.5 miles an hour and is scheduled to make a maximum speed of 70 miles and is reported as actually reaching 90 miles. It is a five-car train weighing 175 net tons. The Erie reports an excellent performance, namely, 45.9 miles an hour for 140 miles with seven stops, or 57 miles an hour deducting stops. This train carries five and six cars and is rated at 212 tons behind the tender. The maximum speed touched is not reported. In the same table the Southern Pacific reports a train remarkable for the length of the engine-run, although not remarkable for speed. This train runs 309.5 miles between Oakland and Bakersfield. The journey speed is 40 miles an hour with six stops and deducting stops the run from terminus to terminus is made at the rate of 44.8 miles an hour. The highest schedule speed is 48 miles, the train carrying six cars. This run is made without a change of engine, namely, 309.5 miles. Under this class the Boston & Maine has a train running 112 miles at 40.7 miles an hour, including four stops and scheduled to go up to 66.4 miles an hour and actually reaching 72 with five cars. The Vandalia has a four-car train running 240 miles and making 15 stops at an average of 42 miles an hour or 49 miles an hour without the stops. This train is scheduled to reach 60 miles and does reach 80.

(2) Naturally, it was not easy to draw a sharp line between light and heavy trains, and so we find in the table of heavy and fast trains the famous Philadelphia & Reading Atlantic City train, the fastest in the world, which is rated as carrying six cars and weighing 170 tons behind the tender. This train, as everybody knows, makes 66.6 miles an hour for 55½ miles with no stops. The maximum schedule speed is 70 miles and the maximum actually reached is not reported. We know from our own observation and careful timing of successive mile posts that this train does reach 75 miles an hour and probably it often runs faster. In this class the next best train is that of the Pennsylvania, also between Camden and Atlantic City, 58.3 miles without stop at 63.6 miles an hour. The maximum schedule speed of this train is 71.3 miles and the maximum reported as reached is 79.7. This train carries eight cars and weighs 287 tons behind the tender.

In this table the Cleveland, Cincinnati, Chicago & St. Louis reports a train running 266 miles with 11 stops at a journey speed of 44 miles an hour and a speed between terminals, deducting stops, of 50 miles. This train is scheduled to touch 59½ miles an hour and is reported as reaching a rate of 80 to 90 miles. It carries seven to 10 cars and weighs 350 to 450 net tons behind the tender. Another remarkable thing about this train is the length of the engine run, namely, 266 miles without change. The Chicago Great Western also has one engine run of 266 miles, but the weight and speed of train are not remarkable. In this table the Southern Pacific reports another train running 309.5 miles without change of engine. It is a heavy train but only moderately fast. The Boston & Maine gets into this table with a good train, namely, 108.5 miles with six stops at 36.4 miles an hour journey speed or 42.8 deducting stops. The

maximum schedule speed is 53.3 miles and the maximum reached is 65 miles an hour. The train is heavy, 10 cars weighing 376 tons. In this table the Plant System reports a good train, namely, 172 miles with six stops at 42¼ miles an hour journey speed and 51¼ miles deducting stops. The highest schedule speed is 66 miles an hour and the maximum touched is 74. This is an eight-car train weighing 375 tons and the run of 172 miles is made without change of engine. In both of these tables other roads report trains which are noteworthy for weight or speed, or both, but if the reader cares to know about them he should get a copy of the Bulletin.

(3) The speeds reported in 1889 seem hardly worth mentioning in comparison with the figures given above. The Pennsylvania train for instance to Atlantic City makes 45.6 miles an hour, while the best train on the New York Central between New York and Buffalo is recorded as making 41.3 miles an hour with three stops. There are only three entries in the column of maximum speed touched during the journey and the best speed there is 60 miles an hour. The longest engine run there given is 181 miles, on the Chicago, Rock Island & Pacific, which, by the way, is run without a stop, the average speed being 33 miles an hour.

Another reporter gives facts of like trains in other countries, but his tables are not so well arranged as those of Mr. Slack and therefore we must put off any abstract of his report for some later issue.

Acceptance Tests for Locomotives.

On another page we publish two letters on the above subject. The suggestion of such tests is novel and interesting and the paragraphs to be incorporated into specifications are elaborated with considerable care. The objections to the plan which will at once arise are well summed up in the second of the two letters. Without further thought we are not prepared to either recommend or discourage the suggestion, but put it forward for the consideration of locomotive builders and locomotive buyers. It is made by a gentleman who has had a good deal to do with both classes. Meantime, we venture a few suggestions.

A locomotive which has been subjected to such a test as has been outlined, would possess a higher value than a similar machine which had not been thus tested. The simple fact that prescribed conditions of load and speed had been maintained by it, would be proof that its bearings were ready for service. If the steam pressure had been well maintained, there could be no question as to the efficiency of the front end arrangement. If the guaranteed performance had been obtained, there would be proof that the heating surface was sufficient and the furnace action satisfactory. If the steam consumption had fallen within the prescribed limits, there could be no doubt as to ports being free, the cylinder clearance satisfactory, the valves well set, and the valve gear capable of performing the service for which it had been designed. In these and in many other respects as well, the new locomotive would have been fully proved before delivery. The buyer of an engine which had been thus tested would know, without further trial, that the locomotive as delivered could be depended upon to do a definite amount of work, in return for a definite expenditure of fuel.

It is essential that a specification drawn along lines such as have been suggested be at first very liberal to the builder, but as the volume of data derived from such tests increased, builders in competition would find it to their advantage to guarantee higher and higher performance. By such a process locomotive design would be carried from one step of development to another which is higher, until the difference between the actual performance of such engines and their possible performance under ideal conditions would fall within the narrowest possible limits.

The promoter of special apparatus would find in the adoption of an acceptance test a sure basis upon which to exploit his wares. A feed-water heater, a new valve gear, a smoke consumer, or any similar device which, as is sometimes alleged, will effect a saving of from 5 to 15 per cent., should if adopted operate to advance the guaranteed performance of the engine as a whole. The relative advantage of the simple and compound locomotive would become less a matter of speculation and more a matter of dollars, as represented by the relative performance which designers or builders could guarantee for each of the two types. The adoption of an acceptance test would in fact have a refining influence upon every important element entering into the problem of locomotive design; useless details would soon be dropped, those of low efficiency would soon be improved or would give place to better ones, and the best would be made better. Such a test would not work a permanent hardship for the builder. If at first he were required to meet the cost, he would soon arrange to have purchasers carry such portion of it as should fairly fall to their share. It will be of interest to note in this connection that builders of pumping machinery have not suffered, but on the contrary have benefited from having been required to guarantee a duty performance and one may naturally expect that builders of locomotives would under similar conditions be equally fortunate.

A guaranteed performance sustained by an acceptance test may result from the demands of purchasers or from the voluntary action of locomotive builders. A road contracting with a single builder for a considerable number of locomotives might require some or all of the individual machines to be tested before delivery. On the other hand, it would seem that the time is now, if ever, especially opportune for the builders to take the initiative by offering to guarantee the performance of the engines they build. In addition to the direct and permanent advantage which would result from such a process, its indirect value would be considerable. Few things increase the confidence of the purchaser so much as a reputation for thoroughness on the part of the builder. It is well known that certain makers of stationary engines have often won in competition because of their having adopted the practice of erecting and testing their machines before sending them out, and it is not likely that American locomotive builders who seek to extend their field would suffer loss by maintaining and keeping occupied a locomotive testing plant.

Notes on the Prairie Type Locomotives.

We recently had an opportunity to ride on one of the notable Prairie type engines, now running out of Chicago, on the Chicago, Burlington & Quincy. These engines have wide, deep fire-boxes and have been referred to so often as to need no description here; last week we published a brief account of their satisfactory performance. From observation and inquiry it is evident that the new Burlington engines are well adapted to the fast freight service in which they are used and besides showing a saving of at least 15 per cent. of fuel over other engines in the same pool, the wide fire-boxes are held in high favor by enginemen and firemen. On this particular trip a good quality of lump coal was used, but inferior coal can be burned. With but one wide fire-box engine on a division it is impracticable in regular working to supply that engine with a poorer grade of coal than other engines will burn, but engines of the Prairie type are burning lignite coal on the Burlington & Missouri River.

With a train of 37 loaded cars, an average speed of 30 miles an hour was easily maintained and the engine steamed freely at all times. There was a noticeable absence of black smoke, although the engine was fired in the usual way; that is, three or four shovels of coal were put in at a time and the smoke would be brown for a few moments, but the discharge from the stack quickly cleared. There can be no doubt that the work of the fireman is materially lightened by using the short, wide grates.

There seems to be some difference of opinion among the enginemen as to the necessity of using two fire doors with these engines. Some prefer two doors, the same as now used, but others hold that one door somewhat wider than is the common practice is all that is needed. In support of the latter view, it can be said that some firemen charge most of the coal through one door, although it is situated well to one side, and even then they appear to have no difficulty in distributing the coal over the grates. If such an engine can be fired satisfactorily through one door it would seem to be of little use to complicate the construction of the boiler with the second door where the fire-box is deep and about 6 ft. wide.

The working of the piston valves and valve gear is all that could be expected and it is thought that without the free movement of the reverse lever given by the piston valves it would be difficult to handle these engines in the narrow space left for the engineman between the side of the boiler and the cab. In the new Prairie type engines now ordered from the Baldwin Locomotive Works, the cabs will be set further back, and there will be more room for the engineman.

There is practically no rolling of these engines from side to side, due probably to the effect of the outside bearings of the trailing wheels. With a light train, however, and running at speeds above 20 or 25 miles an hour, the rear of the engine with the present arrangement has a decided movement from side to side on straight track, most of which it is thought can be prevented by modifications in the trailing truck rigging. The driving wheel base is 11 ft. 4 in., the front truck wheels and truck drivers are 7 ft. 11 in. center to center, and the rear drivers and trailing wheels are 7 ft. centers, making the total wheel base 26 ft. 3 in. To allow for sharp curves considerable play is given at the rear journal boxes, and this permits of a side movement of the rear of the engines at high speeds. As now arranged the load on either side at the rear is carried on a plate resting on rollers and the rollers are free to move on a concave plate on top of each trailing journal box. When certain modifications are made the engines will doubtless ride very easily and still curve freely.

The main frames and the frames of the trailing wheels, which are off-set, are both connected to a heavy cast steel cross bar just ahead of the fire-box. Some designers have thought that these joints in the frame would be difficult to maintain, as they receive all the pulling and buffing forces, but no trouble of this kind has been experienced and the joints remain perfectly tight after six months of hard service.

A part of the new Prairie type engines of the Burlington are replacing old 20 x 24-in. consolidation engines which weigh about 110,000 lbs. These consolidation engines are no longer suited to the service and have been withdrawn from road service. They are now being converted into six-wheel switchers, and the change is made in an interesting way. The pilot, leading truck wheels, the rear drivers and boxes and back rods are removed and the rear flanged tires are put in place of the blind tires of the main drivers. Then a plate is bolted to the frames at the rear covering the rear pedestals, and the equalizers are re-adjusted. The result is a very good six-wheel switcher, weighing about 98,000 lbs., and the value of the scrap material is just about equal to the cost of making the alterations.

Annual Reports.

Wisconsin Central.—The annual report of this company is the first that has been issued by the reorganized company, whose organization dates back to July 17, 1899, and it shows how the need of increased expenditures for improvement work may more than keep pace with the expansion in revenues. Last year's expenses, chiefly on maintenance account, increased $523,000, or 17 per cent., whereas the increase in gross earnings was $519,000, or 10 per cent. Of the larger expenses, $264,000 was on account of maintenance of way and equipment. In addition, all but $42,000 of the surplus of $492,915 earned over fixed charges (over 4½ per cent. on the preferred shares) was appropriated for improvements.

This amount, however, was only two-thirds of the expenditures for roadway betterments, while $630,591 was expended for additional equipment. The total charges for improvements and equipment aggregated $1,255,843, of which $542,498 was provided by the sale of new first mortgage bonds; $450,747 was realized from the appropriation of the year's surplus and $262,598 was cash turned over by the reorganization managers. The new equipment consisted of 10 locomotives, 500 box cars, and also of ballast cars and steam shovels necessary in the important work of reconstruction now begun under systematic plans. Most of the work classified last year as improvements consisted of new yards (of which the cost was $223,338); new shops, safety appliances (which cost $120,308), coal docks, passing tracks, spurs and mine tracks and similar work to provide increasing facilities for the company's enlarging business. Some work was done in improving alignment, revising grades and widening embankments, but the report states that this work had barely begun at the close of the fiscal year. The expenditures for grade revisions during the rest of the calendar year were estimated at $200,000.

With the completion of work now under way on one division between Fond du Lac and Abbottsford, the maximum train tonnage will be doubled. This work will be continued on other divisions, it is announced, as fast as the finances permit. The recital of this work has special interest because while it has long been needed it could not be undertaken previously, not only because of the state of revenues but because of the peculiar organization of the company. The Wisconsin Central lines were really 13 more or less independent companies, each with its own stock and bonds outstanding. General plans for improving and developing the line, requiring the assent of many of these companies, each with different interest, could seldom be carried out. The fundamental idea of the reorganization has been to get rid of this condition and to give the new company a clear title in fee to all the property which it operates.

Extensive improvements have been all the more essential because the company's main line between St. Paul and Chicago is in highly competitive territory. Although it is one of the oldest lines between these points it is one of the longest, 462 miles against a short distance of 410 miles, with the through traffic divided between five lines. Moreover, the company is without terminals of its own at St. Paul, Minneapolis, Milwaukee and Chicago, and 65 miles of the 950 miles operated are leased lines. Two important steps towards securing new terminals have been taken during the past year by concluding long term agreements with the Illinois Central for its station and tracks in Chicago and with the Great Northern for that company's line between St. Paul and Minneapolis and the Union stations in the two cities. In addition, the company has issued $500,000 in bonds for new freight terminals at Minneapolis and made a five year lease with the St. Paul for 28 miles of its track into Milwaukee and its terminals there. On its own line the well-known car shops at Steven's Point and the locomotive shops at Waukesha, Wis., have been abandoned and concentrated in the new plant at Fond du Lac, while new terminal yards have been built at Ab-

bottsford and Fond du Lac, in place of old terminal yards abandoned.

Last year's large increase in tonnage and revenue was in good part due to the activity in iron industries, the company's lines reaching the ore mines in Northern Michigan and Wisconsin. The ore tonnage last year yielded 36 per cent. of the total freight traffic. Of the increase of 353,000 in tons carried, 128,000 was in ore and 101,000 in lumber, which is the second largest class of freight, and about 10 per cent. of the total.

In the October issue of the Bankers' Supplement to the *Financial Chronicle* the leading paper is by Mr. O. D. Ashley, President of the Wabash Railroad, on "The Business Outlook." Mr. Ashley says that leaving out the uneasiness caused by the election all conditions upon which business prosperity depends are highly favorable to its indefinite continuation. The crop prospects on the whole are satisfactory. The deficiency in quantity is offset by the increased value of the product. A diminished volume of trade was caused in the early part of the year by high prices; this condition has now practically arranged itself and the country is beginning to feel the benefit of renewal of orders. Mr. Ashley thinks that the reduction in the price of rails will bring in orders that have been held back. He pays his attention to trusts and says that the true remedy is in regulation and publicity. Legislation may provide against fictitious capital and require periodical statements of business and thus protect the people from speculative deceptions, but any attempt to prevent such consolidations will not only be ineffectual but against the public good.

NEW PUBLICATIONS.

Transactions of the American Institute of Mining Engineers. Vol. XXIX; February, 1899, to September, 1899, inclusive. New York: R. W. Raymond, Secretary. 1900.

This volume of the Transactions of the Institute contains 1,074 pages, including the usual copious and excellent index. It gives the list of officers and honorary members, a list of meetings, the proceedings of the two general meetings held in 1899 and a long list of papers submitted during the year, together with discussions thereon.

Hydraulic Power Engineering. A Practical Manual On the Concentration and Transmission of Power by Hydraulic Machinery. By G. Croydon Marks. Small octavo, 360 pp., index and 200 illustrations. New York: D. Van Nostrand & Co. 1900. $3.50.

The author of this small volume does not assume to cover the broad field of hydraulics and hydraulic engineering in general, much less in detail, but he does aim to give an outline of the fundamental principles that must be obeyed and of the most essential points in design that must be kept in mind by the man who would plan and build works and apparatus for the use of water to transmit power. He illustrates the principles and design by examples in detail of special appliances. The first three chapters deal with general principles, with hydraulic pressures and with the flow of water. Materials of construction, loads and stresses are next considered, and the third part of the book takes up packings and joints, which are treated in considerable detail. Then the author deals with valves, lifting machinery and motors. There is a short chapter describing a few recent remarkable works, and there is a table of pressures up to 270 ft. head and one of pump performance.

The author points out that it is necessary to divide hydraulic machinery into at least three classes according to pressures used. He has designed hoists to work at 5 lbs. per sq. in. and ordnance testing plants working at 6½ tons, a pressure equivalent to a column of water nearly 6½ miles high. In hydraulic work we have a range of pressures from say 5 lbs. to 22,400 lbs. per sq. in., while in steam engineering the practical range is from 7 lbs. to 300 lbs. On the other hand, the range of temperature is not to be considered in hydraulic machinery, but dictates the modifications of design and material in steam machinery. So, for his purposes, the author divides hydraulic pressure machinery into three classes: (1) Those working below 200 lbs.; (2) those working between 400 lbs. and 1,500 lbs.; (3) machines working at pressures of from 1 ton to 10 tons per sq. in. Obviously, the design of cylinders, packing, joints, etc., may be and should be quite different for these three classes. The discussion of these details is quite complete and illustrated with numerous drawings. The chapters on lifts, cranes and presses which fill 67 pages are also reasonably complete, but more space might well have been given to stamping and forging presses and to riveters. The theory and the design of turbines, water wheels and hydraulic engines are discussed in 75 pages, and as well as it could be done in this space.

Many of the purposes for which the Englishman uses water the American engineer has chosen to accomplish by the direct application of steam, or by steam power transmitted by compressed air or by electricity. It seems likely that this tendency will be carried still further as the art of using these latter agents is improved; but there are certain operations, involving great power and slow and limited motion for which hydraulic transmission is pre-eminently suited and some for which it seems indispensable. In such applications the American engineer has much to learn from England, and this little volume is a lucid, compact and scholarly introduction to knowledge of the principles and details of the art.

TRADE CATALOGUES.

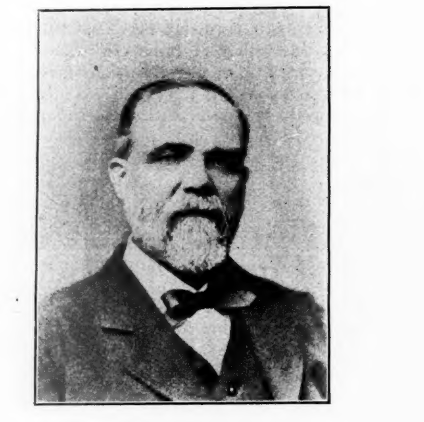
Packings.—The H. W. Johns Mfg. Co., 100 William street, New York, have issued a little pamphlet advertising the Kearsarge asbeto-metallic packing. This packing is made of asbestos yarn and strands of fine brass wire coated with a special rubber composition. It is intended for high-pressure steam and has great strength, elasticity and heat resisting properties. It adapts itself to uneven surfaces and makes a superior flat packing. The pamphlet and any particulars and samples of the packings can be had on application.

Gasoline Engines.—The Charles A. Stickney Co., St. Paul, Minn., sends a new illustrated catalogue of gasoline engines with single, double and triple cylinders, beside which there are shown combinations of gasoline engines with stationary pumps, air compressors and hoists. A number of portable combinations with gasoline engines are made, including centrifugal and plunger pumps, air compressors, wood saws, blowers, hoists, concrete and mortar mixers, and electric light and power plants. All engines are of the vertical type and are tested under working conditions before shipment is made.

Watts Cooke.

Mr. Watts Cooke, President of the Passaic Rolling Mill Co., of Paterson, died on Sept. 25, and we are reminded that the generation of old-time mechanical engineers, who spent the best part of their lives in constructing and maintaining early railroad machinery under difficulties and discouragements now unknown, is fast disappearing. Mr. Cooke was born at Matteawan, Dutchess County, N. Y., Nov. 27, 1832, and went to Paterson in 1839. At an early age he showed a talent for mechanics, and in 1848 became an apprentice in the locomotive shops of Rogers, Ketchum & Grosvenor, where his brother, John Cooke, was Superintendent. Young Watts was a bright boy and soon won the favor of the senior partner, Thomas Rogers, who, though a kindly man, was not only an indefatigable worker himself but required the very best efforts on the part of his apprentices and subordinates.

At that time Rogers and John Cooke were studying steam economy, making a number of wooden models of slide valves and cutoff gears. When they had worked these out to their own satisfaction, they placed them before young Watts for him to study and report on. As he was invariably required to give a reason for his opinions, no matter whether they were adverse or favorable, he soon acquired the habit of thinking and reasoning for himself. This was the foundation of his successful engineering life.



Watts Cooke.

In 1852-53 John Cooke resigned from the Rogers Works and became one of the organizers of the firm of Danforth, Cooke & Co., locomotive builders at Paterson, where he took the position of General Manager and Superintendent. Watts Cooke, not wishing to be parted from his brother, arranged with Rogers to cancel his indentures, and he immediately entered the employ of the above-named firm as Assistant Superintendent.

At about the same time, the Directors of the Delaware, Lackawanna & Western Railroad were giving much attention to the development of their anthracite coal trade, and, after many conferences with Superintendent Dotterer it was decided to order a hard-coal burning locomotive from Danforth, Cooke & Co. The order was signed by President Phelps, Oct. 18, 1853, with instructions that the engine should be named "Anthracite." It was a six-coupled engine with a pair of small leading wheels, the wheel base being rigid. The frames stopped at the front of the fire-box, which permitted it to extend over the track (6-ft. gage). Watts Cooke delivered this engine himself, taking it over the Erie Railroad to Scranton, via Great Bend. The engine did not curve well and when near Cochecton she ran off the track but no serious damage was done and the engine was delivered at Scranton, May 10, 1854.

Although the "Anthracite" was not altogether a success it produced a favorable impression on the Directors, who determined to experiment still further with hard-coal burning engines, and also to engage a Master Mechanic, and so relieve Superintendent Dotterer who had been acting in that capacity. Their choice fell upon Watts Cooke, who, with all the enthusiasm of youth (he was only 22 years of age) plunged at once into the duties and responsibilities of that office.

Space will not permit a description of his varied and painful experience with the rolling stock of the old Lackawanna Railroad, but it must suffice to say that with the engines he had, some being inside connected 10-wheelers with outside frames, and some with short wheel bases and ponderous overhanging fire-boxes; a crooked track having a 56-lb. rail with very few ties and no fishplates; a poorly-equipped repair shop, severe winters, the like of which do not seem to come in these days, with terrible snow storms and cold that stalled the trains and even froze the water tank at Clark's Summit; with the ever present hard-coal burning engine problem, Mr. Cooke's life was one of continual toil and anxiety.

After experimenting with various anthracite coal-burning fire-boxes, Mr. Cooke rebuilt the old wood-burning engine named "Ontario," making a long fire-box without overhanging weight. This was a success, and was examined by all the locomotive builders of the time. The Directors ordered six engines of similar design, and their efficiency induced the Erie and New York Central Railroads to adopt hard-coal burning engines, with the result of a large increase in the Lackawanna coal trade.

In 1864 Mr. Cooke was appointed Superintendent, a position which he filled until 1868, when he retired, and became Superintendent of the Passaic Rolling Mill Co., of which he was one of the organizers, and was elected President in 1873.

Mr. Cooke was a man of sterling worth and integrity and filled several positions of public trust. He was, moreover, of a kindly and genial disposition; was a member of the Presbyterian Church and died lamented by a large circle of friends. His widow and five children survive him. He was buried at Cedar Lawn Cemetery, Paterson, Sept. 27, 1900.

HERBERT T. WALKER.

Paris Exhibit of the American Steel & Wire Company.

The exhibit of the American Steel & Wire Company at the Paris Exhibition was one of the most complete and interesting shown. It was in the Department of Mines and Metallurgy and was not placed with the other exhibits from the United States for want of room. On the main floor it occupied a space of 50 x 50 ft. and included there iron ores, coal, limestone, coke, pig iron, ingots, blooms and billets. In the center was an ornamental bronze pagoda containing panels illustrating various manufactured products, these being sections of shapes and shaftings, rail splices, horse shoes, wire springs, insulated cables, etc. Surrounding the pagoda were samples of sheet steel bent and stamped, boiler heads, wire rods, rail bonds, etc. In fact, the exhibit covered almost the entire range of the steel industry. It was designed and arranged under the personal supervision of Mr. P. W. Moen, Third Vice-President, and of Mr. F. H. Daniels, Chief Engineer. A list of the prizes awarded to this exhibit follows:

Four grand prizes, two gold medals and a collaboratory gold medal each to President Palmer and Chief Engineer Daniels.

One grand prize, class 26, for iron and steel galvanized telegraph and telephone wires, pure copper wires, insulated conductors, rail bonds, trolley wires, feeder cables for light and power, aerial, underground and submarine cables.

One grand prize, class 7. Music wire, for greatest tensile strength, ductility and high finish.

One grand prize, class 63. Covering metallic ores, coal and coke, also natural mineral paints, such as Venetian red and copperas, of which this company is the largest manufacturer in the world.

One grand prize, class 64. Covering pig iron, steel in ingots, bars, sheets, finished plates and wire rods; also copper and copper alloys, ingots, bars, etc.

One gold medal, class 30. Covering bicycle and carriage wire spokes and kindred products.

One gold medal, class 65. A general metallurgical class, including wire nails and tacks, barbed wire, wire rope, horse shoes, woven wire fencing, springs, chains, staples, wire netting and kindred products of the wire industry.

A grand prize was voted on class 65, but withdrawn because a grand prize had already been awarded in classes 63 and 64, closely related to class 65.

One gold medal to William P. Palmer, President American Steel and Wire Company.

One gold medal to F. H. Daniels, Chief Engineer American Steel & Wire Company.

Compressed Air Plant for Rapid Transit Tunneling—New York.

Messrs. Holbrook, Cabot & Daly, who hold the contract for the third section of the underground rapid transit tunnel, New York, have just completed the installation of a compressed air plant, at the northeast corner of Union square. The plant occupies a space of 100 x 120 ft., and is equipped with five boilers, each having a capacity of 100 h.p., two Ingersoll-Sargent straight-line air compressors, cylinders 24 x 30 x 30¼ in., with a capacity of 250 h.p. each.

Natural draft is obtained by two iron stacks 80 ft. high by 48 and 56 in. in diameter respectively. In compressing, the air passes through the receiver, thence into the main pipes which extend 4,000 feet in each direction along the line of the tunnel, making a continuous pipe line of more than 1½ miles.

The first half of the main pipe line in each direction is of 5-in. pipe and the last 2,000 feet is of 4-in. pipe. The main pipes have three T-connections to each city block. These connections are of 3-in. pipe, from which 2-in. pipe connections are made with the engines.

The compressed air generated at this station is not

only used for the hoisting engines, but is also used for drills, riveters, wood working machines and stone dressing. It was a question at first as to what power should be used. Independent steam engines along the line of operation would have been the most economical, but would also have been the most annoying to the general public. Electric current was too expensive to buy, and it was not deemed advisable to install an electric plant. Therefore compressed air was decided upon, it being considered, next to steam, the most economical, and by far the least annoying.

There is another compressor plant at 42nd street and still others are to be installed throughout the different sections. Section three, for which the above described plant is used, extends from Great Jones street to 33rd street.

TECHNICAL.

Manufacturing and Business.

The American Dust Guard Co., of Columbus, Ohio, has received an order from the Pressed Steel Car Co. for 48,000 dust guards for use on cars to be built by that company for the Baltimore & Ohio.

E. A. Wurster, Secretary and Treasurer of The Falk Co., Milwaukee, Wis., sailed Oct. 6 on the Pennsylvania, of the Holland-American Line, for a three months' trip to Europe. He will visit France, Germany, England, Ireland and Scotland.

W. W. Holmes, Superintendent of The Q & C Co. shops for over twelve years, died at Bridgeport, Conn., Oct 15. Previous to going to The Q & C Co. he was a member of the firm of Glines & Holmes, of Bridgeport, Conn. Mr. Holmes was 41 years of age.

The Adams & Westlake Company announce the death of Mr. James W. Cross, which occurred in Philadelphia, Oct. 6. Mr. Cross was identified with the interests of that house for many years. He was a man of high character and warmly esteemed by those who had known him in his long and active business life.

The Rand Drill Co. has removed its main office from 100 Broadway, New York, to the fifteenth floor of the new building just erected by the American Exchange National Bank, at 128 Broadway, corner of Cedar street, to which place all future correspondence should be addressed. In its new office the company will occupy the entire floor, in conjunction with its allied interests: The Pneumatic Engineering Co., and the Rendrock Powder Co., and the Davis Calyx Drill Co.

Iron and Steel.

George Beard, President of the West of Scotland Iron & Steel Institute, is in this country to visit some of the leading steel plants.

John Price, Inspecting and Consulting Engineer for the Great Southern & Western Ry. of Ireland, arrived in New York on Oct. 12.

George B. Berger, Treasurer of the Shenango Valley Steel Co., until its absorption by the National Steel Co. last year, died in New Castle, Pa., Oct. 11. Mr. Berger entered the iron business as General Manager of the Raney & Berger Iron Co.

A company by the name of the Moore Drop Forging Co. is being organized in Springfield, Mass., by A. L. Moore, for many years Manager of the Springfield Drop Forging Co. Preliminary officers have been elected as follows: President, H. E. Marsh; Treasurer, A. L. Moore; Secretary, F. S. Sibley. Others interested are: T. W. Leete, C. T. Shean and G. M. Hendee.

Rodman Wister, of L. & R. Wister & Co., of Philadelphia, has been elected President of the Duncannon Iron Co., to succeed his brother, the late John Wister, who was an officer of the company 40 years and President for the past 20 years. J. B. Lequear succeeds the late W. E. S. Baker as Secretary. Joseph B. Jackson is Treasurer and George Pennell is General Manager.

The Glasgow (Scotland) Corporation is in the market for the following: 3,000 tons of street rails, 300 tons of curved rails and 150 tons of steel fish plates. Forms for bids may be had from John Young, General Manager, 88 Renfield street, Glasgow. For the same corporation there is needed ten miles of cast-iron water-pipe, varying in size from 6-in. to 14-in. Specifications, etc., may be had from Kyle & Frew, 140 West George street, Glasgow.

Steel Platforms.

We have much pleasure in saying that the Standard steel platform is now in use on 100 railroads in the United States, Canada and Mexico. There has been a steady extension of its use since it was introduced in 1897.

The Rockville Bridge.

A few months ago we described, with illustrations, the new bridge which the Pennsylvania is building across the Susquehanna River at Rockville, just below Harrisburg. It appears that the summer has been uncommonly favorable for carrying on that work. The river was never lower and the contractors have had dry land to work on for a good part of the way across. They have not lost a day on the piers because of bad weather and none of the work has been damaged by high water. Consequently, the contractors have been able to do a good deal more than they had estimated on.

Locomotives for Turkey in Asia.

The Ottoman Government is reported to be in the market for six four-axled locomotives and tenders, to be delivered and erected in Asia Minor. The gage is 1.05 meter; engines and tenders are not to exceed 2.50 meters in length. Both engines and tenders must easily pass curves of a radius of 50 meters. The tractive power must be 5,000 kilograms, and the effective power 370 h.p. The engines are not to exceed a height of 3.60 meters measured from the rails. Bids will be received by the Minister of Commerce and Public Works at Constantinople. Bids must be accompanied by a sketch of the engines and tenders as they will be built. Sketches and explanatory remarks must be in duplicate.

Pintsch Light in New Zealand.

The annual report on the New Zealand Government Railroads for the year ending March 31, 1900, was recently received. The introduction is by the Minister of Railways of that Colony, the Honorable J. G. Ward, who says that the Pintsch gas system which has been adopted for lighting their carriages continues to give satisfactory results and meets with the approval of the traveling public. Five gas plants have been erected and seven traveling storeholders built and 439 cars fitted up. The total gas produced for the year ending March 31 amounted to 1,500,000 cu. ft. The department has learned that after providing for operation, interest and depreciation of fixed plant and car equipment there is an actual saving as compared with kerosene oil. The annual charge in the case of gas amounted to £5,550 as compared with £6,160 for kerosene lighting. This satisfactory result will be improved as the gas consumption increases. Mr. A. L. Beattie, Locomotive Superintendent of the Colonial roads, makes a special report on this method of lighting, which it appears was installed first at Dunedin, in 1896. Plants have since been established at Christchurch, Wellington, Palmerston North and Auckland. Cars which do not run to a gas station are served by traveling storeholders on platform cars, which carry 5,000 cu. ft. at a pressure of 10 atmospheres. The car reservoirs are charged to seven atmospheres and supply four duplex burner lamps for about 40 hours, or practically one week's service on ordinary trains in winter months. A car is re-charged in from three to four minutes. The oil principally used for making gas has been once-refined British shale and once-refined New South Wales shale oil. New Zealand petroleum has been tried with good results, and it is hoped that an ample supply of this local oil will be procured. The cost of production has been increased by the fact that the working was intermittent, but with additional storage capacity now being provided longer periods of continuous gas making will give some economy as to cost of heating up retorts and attendants will be diminished. The actual cost has been 1.33 pence per lamp per hour, the lamps consuming 1.5 cu. ft., or for four lamps in a car 5.32 pence per hour. An equivalent light from kerosene cost 5.92 pence per car mile. In both cases interest and depreciation on car equipment are included. Mr. Beattie says "the first cost of equipment of cars for Pintsch gas is greater than for kerosene lighting, but the result of a year's working shows a direct saving, while at the same time a far more satisfactory and reliable light is obtained."

Forgings for Marine Shafts.

The shafts of the U. S. battleship "Wisconsin," which has recently made such a successful trip, were forged by the Bethlehem Steel Company from fluid compressed nickel steel, and those of the Russian cruiser "Variag" were forged from fluid compressed carbon steel. Of course these were made under the hydraulic press and annealed.

Westinghouse Brakes in New Zealand.

The Minister of Railways for New Zealand says that the Government has determined to gradually equip its whole rolling stock with the most modern type of the Westinghouse automatic continuous brake. The contract has been let for the North Island stock to be completed within three years and the express trains in the South Island are also to be fitted at the same time. As a further provision of safety it has been decided to adopt the electric and ordinary staff systems for train working instead of the present train dispatcher system.

Electric Fan Ventilation in the Navy.

In the report of Naval Constructor W. L. Capps, on the battleship "Alabama" as compared with "Kearsarge" and class, he advises the use of electrically driven fans for ventilation. The ventilation of the "Kearsarge" is said to be more satisfactory than that of the "Alabama," this condition being attributed largely to the use of electric fans in the "Kearsarge." The report says in part: "There can be no possible question as to the results obtained in the two vessels, and as the vessel ventilated by electrically-driven fans proved itself so much more satisfactory, it is strongly recommended that electrically-driven fans be substituted for steam-driven fans in all future construction, the development of electric motors at the present time being such as to entirely eliminate the experimental element from such mechanism, which might have been urged against them, with propriety, a few years ago."

The Rogers Locomotive Works.

The latest rumor from Paterson concerning the Rogers Locomotive Works is that an arrangement has been closed with a "New York syndicate" for the purchase by the syndicate of the works. The Chairman of the Paterson Citizens' Committee, which is endeavoring to keep the works running there, speaks guardedly but very hopefully of the arrangement.

New Block Signals on the Reading.

The Philadelphia & Reading has given an order to the Hall Signal Company to equip the remainder of the Bethlehem Branch with automatic block signals. These signals, like those already in use on the Reading, will be Hall disks, a home and a distant signal being provided for each block. The signals will stand normally in the stop position. The portion of this division already signaled is that from the southern end to Lansdale, 25 miles from Philadelphia; and the portion to be equipped is from Lansdale northward to Bethlehem, 32 miles.

The Isthmian Canal.

General Abbott is quoted as having said to a newspaper reporter that he believes that the decision of the Isthmian Canal Commission will be in favor of the Panama Canal as being more feasible and economical and giving better results. He says, further, however, that if the United States does not build the Panama Canal the company will go on building. He is of opinion that if both canals should be built nine-tenths of the ships would go through the Panama Canal, the work on which is now two-fifths done. A dispatch from Colon says that the Canal Company has engaged 300 more laborers in Costa Rica for work on the canal.

Performance of a Heavy Locomotive.

Mr. E. A. Williams, Mechanical Superintendent of the Minneapolis, St. Paul & Sault Ste. Marie, informs us that the heavy compound decapod locomotive recently built by the Baldwin Locomotive Works is doing very good service. During the month of August this engine burned 1,085 lbs. of coal per 10,000 ton-miles, and the average tons hauled per engine mile was 1,245. This performance is better than other compounds, and it is thought that still better records will be made after the engine is well broken in and the crew is accustomed to handling the decapod. The performance of this engine was referred to Sept. 14, p. 609, and a description was published June 22, p. 429.

THE SCRAP HEAP.

Notes.

The Sunset Limited tri-weekly express of the Southern Pacific, between New Orleans and San Francisco, will begin running on November 8.

Press despatches from Havana say that General Wood, Military Governor of Cuba, is thinking of appointing a railroad commission to regulate rates for transportation on existing lines and to consider propositions for the construction of new railroads. He has received numerous complaints of excessive freight charges.

A suit has been instituted against the Chicago, Milwaukee & St. Paul in Calhoun County, Iowa, for the recovery of $4,600, because of alleged refusal to comply with the new law that all railroads must redeem unused tickets presented within ten days after purchase. The complainant claims he holds 40 tickets which the company refused to redeem, and he sues for the recovery of the value of the tickets and the $100 forfeit on each.

A special session of the Michigan Legislature, which was called by a proclamation of Governor Pingree, adjourned on Friday last after sitting three days. The Legislature passed both of the measures which were submitted by the Governor; a joint resolution to submit to the people at the election next month a constitutional amendment authorizing the taxation of railroads at the actual value of the property, instead of basing the taxes on the earnings, and a bill repealing the special charters of the Michigan Central, the Lake Shore & Michigan Southern and the Detroit, Grand Haven & Milwaukee railroads. These repeals do not take effect until the end of next year, and meantime the roads are given leave to bring suits for damages.

On the main line of the Omaha Bridge & Terminal Railway train orders are sent by telephone, and to save time in copying the station operators are provided with forms in which the names of the stations are printed. For example, form 44 reads: "Train No. ...... will run .... late from North Junction to Union Pacific Junction." From the sample of this form, which we find in the *Electrical World*, we judge that only for time orders like this (A. R. A. standard form E1) does the road use printed forms. The Omaha Bridge & Terminal is the line over which the Illinois Central enters Omaha. Mr. Annett, Assistant Superintendent of Telegraph of the Illinois Central, says that the despatchers appreciate that feature of the telephone which enables them to know whether or not it is the duly authorized operator who answers when they call.

Traffic Notes.

The rates on flour by lake and rail from St. Paul to New York have been advanced 2.5 cents per 100 lbs.

A press despatch from Pittsburgh says that the railroads have reduced the rate on small steel billets, which has been $4 per ton, to $2.90 per ton to New York.

A minstrel company which travels in a car furnished by itself has lately been detected by a Western road in concealing a number of persons in compartments in the baggage car which ordinarily would be overlooked by a conductor counting the passengers. In these secret compartments sleeping bunks were provided for 10 or more persons.

The Great Northern last week made radical reductions in the rates of fare on its home seekers' excursions (which are run once a week); and the reductions were at once met by the Northern Pacific, which, indeed, made the reductions a good deal larger. From Chicago to Fergus Falls the rate is reduced 50 per cent. and to many other places in nearly as large a proportion. The Northern Pacific applies the reduction to Pacific Coast points also. The Burlington road made similar reductions from St. Louis over its line by way of Billings, Mont.

New Steamship Line from Hampton Roads.

The railroads terminating at Norfolk and Newport News, the Southern, the Norfolk & Western and the Chesapeake & Ohio, have made a joint arrangement to have regular steamship service direct to London, Liverpool, Hamburg and Rotterdam. The object of the combination is to secure better and more regular service, by combining shipments where necessary. When a vessel is to sail from Norfolk the Chesapeake & Ohio (terminus at Newport News) will deliver freight by lighter; while in the case of a vessel sailing from Newport News the other two roads will deliver by lighter. The Southern Railway and the Norfolk & Western have also made arrangements with the United States Shipping Company for shipments direct to Dublin, Belfast, Glasgow, Antwerp and Amsterdam. The freight shipped under this arrangement will have to be lightered to Newport News. It is expected that the other roads terminating at Norfolk Harbor will join in the arrangements above described. The establishment of regular lighterage service will enable vessels to take on a more diversified and a more profitable cargo without being obliged to go to two or more piers to get the freight.

Technical Schools.

University of Illinois.—The total number of students in the University is about 2,500, an increase over last year of 12½ per cent. There are about 1,400 students in the University proper, at Champaign, an increase of 16 per cent. The total Freshmen at Champaign number 350, or 25 per cent. increase, and there are 213 Freshmen in the College of Engineering. This last represents an increase of 60 per cent. over last year.

Massachusetts Institute of Technology.—On Wednesday, Oct. 24, the new President of the Institute, Mr. Henry Smith Pritchett, Ph.D., LL.D., will be inaugurated. Public services will be held at Symphony Hall, Huntington avenue, Boston.

Lehigh University.—Last Thursday, Oct. 11, the annual celebration of Founder's Day was held in the Packer Memorial Church. The address was delivered by the Rev. Simon J. McPherson, D.D., Headmaster of the Lawrenceville School.

American Railroad Cars in Bavaria.

Vice and Acting Consul-General Hanauer, of Frankfort, writes, Sept. 21, 1900, as follows: The Bavarian Government, which owns the railroads and canals in that state, is having a fine American model car built at the Maschinenbau-Aktien Gesellschaft's works, in Nuremberg, for the express train. The woodwork and metal fixtures are furnished by the Pullman Company, which sent out one of its constructors to superintend the building of the car.

The Pan-American Exposition.

The press department of the Pan-American Exhibition, to be held at Buffalo, next year, has issued a handsome pamphlet of 50 pages describing the numerous attractions of the proposed exhibition. Besides the information about the Exhibition the book tells of all the attractive resorts within a hundred miles of Buffalo, and thus will be of special value to foreigners. The managers estimate that the Exhibition is going to cost 10 million dollars, exclusive of exhibits, and no exhibits from European countries will be accepted. The grounds cover 350 acres and the situation is beautiful. The various "courts" will alone take up 33 acres. There are 20 or more large buildings, besides innumerable small ones. The decorative sculpture is being done under the direction of Carl Bitter and the color ornamentation of the buildings is under the direction of Charles Y. Turner. The President of the Exhibition is Mr. John G. Milburn, and the Chairman of the Committee on Transportation is Mr. W. Caryl Ely.

Rolling Stock for the Austrian Southern Railroad.

The administration of the Austrian Southern Railroad is drawing up a plan for the purchase of rolling stock for the year 1901, and it is reported that this plan will be ready to submit to the Imperial Ministry in November or December. A special demand exists for mountain express locomotives, passenger and freight cars. It is said that about 4,000,000 florins will be spent in 1901 for new rolling stock, and 11,000,000 florins for roadbed material, etc. For rails alone some 5,000,000 florins will be set aside, as it is intended to lay a second track on the main lines in Tyrol. The proper authorities may be addressed as follows: General Direction der Oesterreichischen Südbahn, Vienna, Austria.

Crop Conditions on October 1, 1900.

The monthly report of the Statistician of the Department of Agriculture shows the average condition of corn on Oct. 1 to have been 78.2, as compared with 80.6 last month; 82.7 on Oct. 1, 1899; 82 at the corresponding date in 1898, and 81 the mean of the October averages of the last ten years. While the decline during September was not serious, it extended to almost every important corn-growing state. The preliminary estimate of the yield per acre of oats is 29.6, as compared with 30.7 bushels last year, 27.8 bushels in 1898, and a ten-year average of 26.2 bushels. The preliminary estimate of the yield per acre of barley is 20.4 bushels, as compared with a yield of 25.5 bushels last year, of 21.6 bushels in 1898, and a ten-year average of 23.3 bushels. The present indicated yield is the lowest, with one exception, since 1887. The preliminary estimate of the yield per acre of rye is 15.1 bushels, as compared with 14.4 bushels last year, 15.6 bushels in 1898, and a ten-year average of 14 bushels. The average for quality is 92, against 90 last year and 90.2 in 1898. No further report on wheat will be issued pending the receipt of the annual returns of individual producers and the final reports of the Department's special agents.

Boston & Maine Prizes for Flower Gardens.

General Superintendent D. W. Sanborn, of the Boston & Maine, has announced the prizes awarded by the company to station agents for flower displays at the various stations on the line during the past season. The first prize ($50) goes to South Lancaster, Mass., and the second ($40) to Waltham. Six stations receive third prizes of $25 each; eight receive fourth prizes ($20); 16 receive fifth class prizes ($15), and a large number receive prizes of the sixth class ($10), and of the seventh class ($5).

Carnegie and Foreign Shipment.

The Carnegie Co. has chartered four vessels to carry steel from Conneaut Harbor, Ohio, to Liverpool, via the Welland Canal and the St. Lawrence River. The vessels are the "Leafield," "Theano," "Paliski" and "Monkshaven." Three were built at English yards and one at Rotterdam, and were intended for European coastwise service. Their capacity is about 2,500 tons each on 18 ft. of water. It is proposed to load the vessels with about 1,000 tons of steel at Conneaut and fill out at Montreal with about 1,500 tons of other cargo. The first shipment will be on Nov. 5.

LOCOMOTIVE BUILDING.

The Laurel Lumber Co. is having one engine built by the Baldwin Locomotive Works.

The Florida East Coast is having five engines built by the Schenectady Locomotive Works.

The Greenwich & Johnsonville is having one engine built by the Schenectady Locomotive Works.

The Toledo, St. Louis & Southwestern has ordered 10 locomotives from the Baldwin Locomotive Works.

The Chicago, Rock Island & Pacific is reported as about to order 20 locomotives. We have no official information.

The Colorado Midland recently ordered five Vauclain compound consolidation engines from the Baldwin Locomotive Works.

The Union Pacific is having 32 engines built by the Baldwin Locomotive Works, instead of 27, as stated Aug. 10. Eight will be heavy Vauclain compound consolidation locomotives, eight heavy mogul locomotives of the Vauclain system, three six-wheel switchers with 20 in. x 28 in. cylinders, and 13 of the same type with 19 in. x 26 in. cylinders.

The New York Central & Hudson River order with the Schenectady Locomotive Works, referred to last week, calls for delivery between January and April next. The engines will be for passenger service, weigh about 167,000 lbs., with 95,000 lbs. on the driving wheels, and have 21 in. x 26 in. cylinders; 79-in. driving wheels; straight boilers with charcoal iron tubes and a working steam pressure of 200 lbs.; fire-boxes, Carbon steel, 102 in. long and 75 in. wide; and a tender capacity for 5,000 gals. of water and 10 tons of coal. The special equipment will include Westinghouse brakes, Sansom bell ringers, National hollow brake-beams, Gould couplers on tenders, Monitor injectors, U. S. metallic piston and valve rod packings, Consolidated safety valves, Leach sanding devices, Nathan lubricators, French springs, Consolidated system of steam heat, and Paige 36-in. tender wheels.

CAR BUILDING.

The Illinois Terminal is reported in the market for 50 coal cars.

Nelson Morris & Co., Chicago, are asking bids on 100 refrigerator cars.

The Seaboard Air Line is asking bids on 20 passenger and five express cars.

The Pennsylvania has asked bids on 1,000 freight cars, 600 of which will be box.

The Norfolk & Western has ordered 50 freight cars from the Haskell & Barker Car Co.

The Florence & Cripple Creek has ordered 125 box cars from the American Car & Foundry Co.

The Atchison, Topeka & Santa Fe is preparing specifications for 600 more hopper bottom coal cars.

The Texas Midland is reported to have ordered 100 coal cars from the American Car & Foundry Co.

The New York, New Haven & Hartford has ordered 400 coal cars from the American Car & Foundry Co.

The Buffalo, Rochester & Pittsburgh has ordered 500 hopper bottom coal cars from the American Car & Foundry Co.

The American Car & Foundry Co. has received an order from an individual coal company for 200 cars of 80,000 lbs. capacity.

The St. Louis & San Francisco is reported to have ordered 100 box and 50 furniture cars from the American Car & Foundry Co.

The Northern Pacific is reported to have ordered eight cars for passenger service from the Pullman Co. The road was asking prices on 20 passenger cars.

BRIDGE BUILDING.

APPLETON, WIS.—Plans are being made by City Engineer Gillett for a drawbridge across the canal at South Division street.

ATLANTA, GA.—We are informed that bids will be wanted probably in the latter part of November for the viaduct on Whitehall street over the Western Alabama and Central of Georgia R. R. tracks. It is to be a steel structure about 600 ft. long, including approaches, and 36 ft. wide. R. M. Clayton, City Engineer.

BARBERTON, OHIO.—The village and the railroad are reported to have agreed to build a $35,000 bridge at Cornell street crossing. W. A. Witner, Village Clerk.

BLOOMINGTON, ILL.—We are informed that there has been much discussion about building three buildings in connection with the plans to eliminate railroad crossings in Bloomington. Nothing is done beyond getting plans and estimates. Elmer Folsom, City Engineer.

BURLINGTON, IOWA.—A company has been found in Burlington to build a wagon and railroad bridge over the Mississippi River. The following are the officers: President, W. H. Fitch, Groton, N. Y.; Vice-President, H. S. Mellinger, Burlington; Treasurer, E. A. Landon, Groton, N. Y., and Secretary, Geo. O. Hay, Burlington. The Business Men's Club is also interested. This bridge, which will be about 2,300 ft. long, was mentioned in our last Construction Supplement (page 554) as estimated to cost $800,000.

CHICAGO, ILL.—Reports state that bids are wanted, Oct. 27, for the proposed bascule bridge over the Chicago River at Clybourn Place. John Ericson, City Engineer.

CLEVELAND, OHIO.—An ordinance was introduced in the Councils authorizing the Director of Public Works to get bids for a rolling lift bridge to replace the Middle Seneca street bridge over the Cuyahoga River. The structure is proposed to have a span of 100 ft. and cost about $100,000. Walter P. Rice, Director.

DAYTON, OHIO.—Bids are wanted, Oct. 27, for a bridge over Bear Creek. A. G. Feight, County Auditor.

DES MOINES, IOWA.—City Engineer Geo. M. King informs us that the city expects to build a bridge over the Des Moines River at East Sixth street within the next 12 months.

DUBUQUE, IOWA.—We are informed that the plans for the bridge proposed by the Dubuque & Wisconsin Bridge Co., over the Mississippi River at Eagle Point, are in the hands of the Secretary of War for final signature, and the contract will be let as soon as the plans are approved. The bridge is to be a steel structure 1,470 ft. long and cost about $135,000. C. H. Meyer, Secretary, Dubuque, Iowa.

FORT BRAGG, CAL.—The Board of Supervisors have ordered bids advertised for, for a bridge across the Garcia River.

JACKSON, MISS.—The Alabama & Vicksburg Ry. has given a contract to the American Bridge Co. for the superstructure of the bridge over the Pearl River at Jackson, Miss.

LEAVENWORTH, KAN.—The County Commissioners want bids, Nov. 5, for a bridge over Nine-Mile Creek. J. W. Niehaus, County Clerk.

LONG ISLAND CITY, N. Y.—The State Board of Railroad Commissioners has made several decisions affecting the Long Island Railroad, relative to grade crossings in Suffolk County. The Blue Point Avenue Crossing, in the Town of Brookhaven, the East Jamesport Lane Crossing, Town of Riverhead, and the Cold Spring Valley Crossing, Town of Huntington, are ordered changed from grade to underground crossings. The Board directs the closing of the old Country Road and Doris Road crossings, in the town of Riverhead, and the changing from grade to the underground crossing of the Raynor Avenue Road, crossing with converging roads to connect with the abolished crossings.

MILWAUKEE, WIS.—The Council last week passed an ordinance providing for an issue of $150,000 bonds for building bridges at Grand avenue and Broadway.

MONTICELLO, MISS.—Bids are wanted, Nov. 5, for $16,000 10-year 6 per cent. bonds, to pay for a steel bridge to be built over Pearl River at this place. Address the Clerk of the Board of Supervisors.

MONTROSE, COLO.—The City Engineer is making plans for a viaduct at Main street.

The Denver & Rio Grande R. R. will, according to report, build a viaduct at East First street.

NEW HAVEN, CONN.—The Committee on Railroads and Bridges is reported considering building a bridge across Mill River at Grand avenue.

NEW YORK, N. Y.—The East River Bridge Commission has let the contract for the approaches to the new bridge to the Pennsylvania Steel Co., at $2,411,000, for both approaches. The towers are expected to be finished in about a month. (Aug. 17, p. 559.)

NIAGARA FALLS, N. Y.—The State Railroad Commissioners have decided that Tenth street shall be opened under the railroad tracks. The work will cost about $80,000, and the cost divided between the city and the railroads.

PITTSBURGH, PA.—Director Wilson of the Department of Public Works is reported as saying that bids for the Tenth street bridge will be wanted in about a week, and that bids will be wanted for the Wilmot street bridge before the end of the month. The Tenth street bridge is to be a steel structure of five spans, with a total length of 1,420 ft., with a roadway 20 ft. wide, and cost about $400,000.

The Wilmot street bridge will have a two-hinged arch central span of about 450 ft., with steel trestle approaches at both sides, and will be about 150 ft. above the bottom of the valley. The estimated cost is $160,000.

The Forbes street or Nine-Mile Run bridge is to be built at a cost of $100,000, appropriated in the last ordinances.

The Fort Wayne Railroad is reported to have agreed to allow the city to build a foot bridge on the Ohio Connecting Bridge, from lower Allegheny to McKee's Rocks.

QUEBEC, QUE.—The North Shore Railway have let a contract for a steel bridge over the Yamaska River to the Dominion Bridge Company, of Montreal. (Sept. 21, p. 627.)

READING, PA.—Application will be made for a charter for the Reading Bridge & Warehouse Co. by John J. Deery, Wm. Abbott Witman, J. Howard Gendel and others, to build a bridge at Sixth and Willow streets over the Schuylkill River to Oakland avenue, Cumru. The estimated cost is $100,000.

An ordinance was introduced in the Councils transferring $13,000 from the contingent fund to build a bridge at Front street and the Lebanon Valley R. R.

ST. CLOUD, MINN.—Bids will be received by the Board of County Commissioners of Stearns County, Minn., on Oct. 20, for a new iron bridge across Sauk River, near the village of Richmond, in the town of Munson. P. J. Gruber, County Auditor, St. Cloud, Minn.

SALT LAKE CITY, UTAH.—We are informed by the Rio Grande Western that the company has let a contract to the American Bridge Co. for 36 steel girders, from 48 ft. to 64 ft. long, to replace the wooden bridges on the line between Salt Lake City and Grand Junction.

SAN JOSE, CAL.—City Engineer Curtis M. Baker is preparing plans and specifications for a bridge over the Guadalupe Creek on or near Fox avenue.

Bids are wanted, until Monday, Oct. 22, at 10 a. m., for a bridge over Dry Creek near Holland's. Address the County Supervisors.

SENECA, KAN.—The Nemaha County Commissioners want bids, Nov. 8, for two 36-ft. iron bridges and one 70-ft. iron bridge with 80-ft. approach. J. T. Sanders, Chairman.

SHELBYVILLE, TENN.—The County Court, on Oct. 2, ordered three steel bridges built across Duck River, one at Hall's Mill, one at the Shofin Ford, and one across the Garrison Fork of the river.

SIOUX CITY, IOWA.—We are informed that the bridge proposed over Perry Creek, at Third street, will be built in the spring. J. M. Lewis, City Engineer.

TOLEDO, OHIO.—The Bridge Commission, in its report, gives the following estimates for the proposed bridges: Jefferson street, $700,000; Cherry street, $400,000; Lagrange street, $750,000, and the Grand street bridge, $600,000. The question of building these bridges will be voted upon at the November election. John E. Connell, City Clerk.

WABASH, IND.—The contract for the ten county bridges, let in August to the King Bridge Co., of Cleveland, Ohio, has since been assigned to the Wabash Bridge & Iron Works, of Wabash.

WASHINGTON, D. C.—The following bids were received, on Oct. 13, by the Commissioners of the District of Co-

lumbia, for building Melan arch bridges in the National Zoological and Rock Creek Parks. a. Zoological Park bridge, 31 ft. 4 in. wide. b. Add per foot additional width. c. Deduct per foot reduced width. d. Rock Creek Park bridge.

	a.	b.	c.	d.
Cranford Paving Co., Washington, D. C.	$18,700	$500	$400	$5,200
James T. Shover, Indianapolis, Ind.	18,400	350	300	2,850
American Bridge Co., New York, N. Y.	17,400	354	362	4,400
O'Hern & Berrigan, Yonkers, N. Y.	18,644	421	421	3,674
Chas. A. Hook & Son, Baltimore, Md.	19,560	1,000	225	3,900
Geisel Construction Co., St. Louis, Mo.	16,850	300	260	2,600
Brennan Construction Co., Washington, D. C.	18,000	500	500	3,900

WINNEMUCCA, NEV.—A narrow gage railroad, to be built from Guthrie to Graham County, Arizona, will need 26 bridges.

Other Structures.

ERIE, PA.—The machine shop of the Erie City Iron Works, makers of boilers and engines, was destroyed by fire, Oct. 9, causing a loss of about $50,000.

LA CROSSE, WIS.—Work is about to be begun on changes and improvements at the Chicago, Milwaukee & St. Paul depot which consist of a train shed 450 ft. long to cover four tracks. The waiting rooms will also be remodeled.

MILWAUKEE, WIS.—The Milwaukee Street Ry. Co. will soon let a contract for a new central barn to cost $500,000. The company has planned to make extensive improvements within the next five years.

PHILADELPHIA, PA.—Bids are invited by the Philadelphia & Reading for improvements at West Milton which will cost about $75,000. The work is as follows: A power house, one-story brick structure, 117 ft. 8 in. x 80 ft. 6 in. An office, oil and storehouse, frame structure, 60 ft. x 16 ft., subdivided. The coaling station will consist of a covered coal dock and trestle, 72 ft. long, 29 ft. wide and 28 ft. high, subdivided into six double coal bins for storage and supply, and an approach 120 ft. long, of timber cribbing. The company will also erect a standard 65-ft. turntable, an 80,000-gal. water tank, a stone and brick ash pit, 96 ft. long, with iron superstructure; a system of water supply and drainage and a system of new track connections incident to changes to be made in the freight yard at that point. A brick and stone arch culvert, with 12-ft. space, and 74 ft. long, and an extension of about 40 ft. to a triple box culvert under the main track, are included in the work, for which bids have been asked.

Regarding the report that the Baldwin Locomotive Works will build an additional building, we are informed by the company that they have bought about one-half acre of land contiguous to their works, but have not decided for what purpose it will be used.

SAVANNAH, GA.—The Savannah Union Station Co. was organized on Sept. 24 and the following officers elected: President, W. W. Mackall, Savannah, Ga.; Vice-President, F. S. Gannon, Washington, D. C.; Treasurer, J. Moultrie Lee, Savannah; Secretary, W. V. Davis, Savannah. The company has acquired land upon which to build the union passenger station in this city. Plans are expected to be ready in 10 days or two weeks. The union depot will be used by the Plant System, Southern Ry., and the Seaboard Air Line.

WACO, TEX.—We are officially informed that the Texas Central R. R. will move its repair shops from Walnut Springs, about 62 miles north of Waco, to East Waco, but the plans are not yet finished. There is a great deal of preliminary work in the way of filling before work on the buildings can be begun. (Oct. 5, p. 660.)

MEETINGS AND ANNOUNCEMENTS.

(For dates of conventions and regular meetings of railroad associations and engineering societies see advertising page xi.)

Association of Civil Engineers—Cornell University.

The next regular meeting of the Association of Civil Engineers of Cornell University will be held in the Association rooms, Lincoln Hall, Ithaca, N. Y., at 2:30 p. m., Friday, Oct. 19.

Franklin Institute.

The stated meeting of the Institute, held Wednesday evening, Oct. 17, was devoted to the reception of the reports of the delegates appointed to represent the Institute at the Paris Exposition. Numerous lantern views showing the most interesting features of the Exposition were exhibited.

New York Railroad Club.

There was no regular paper presented at the meeting of the Club at the rooms of the American Society of Mechanical Engineers, Thursday evening, but discussion was held on the topic "Why Has the Swing-beam Truck So Largely Been Abandoned for Freight Service?"

Western Railway Club.

A meeting of the Western Railway Club was held at the Auditorium Hotel, Chicago, Ill., on Tuesday afternoon of this week. The papers were by Mr. A. Bement, Chemist, Chicago, on "Observations on Smokeless Gases in Fire-boxes," and by Mr. G. W. Beebe, Wheel Inspector of the Chicago, Burlington & Quincy, on "Cast-Iron Wheels."

The Engineers' Club of Philadelphia.

A regular meeting of the Club will be held on Saturday, Oct. 20, 1900, at 8 o'clock, p. m. The paper will be: "The Strength of the Ideal Column, and Its Relation to the Safe Load on a Practical Column: Some New Formulas, and Their Comparison with Older Ones," by Carl G. Barth. At the stated meeting, held on Oct. 6, 1900, the following were elected active members: Messrs. Charles H. Davis, H. D. Hess, F. C. Schmitz, J. Wilbur Tierney and W. N. Walmsley; Mr. L. Erle Edgar to junior membership, and Mr. Adam Laidlaw to associate membership.

Transmission of Power by Compressed Air.

Mr. Fred W. Gordon presented a paper upon the above subject at the meeting, Oct. 6. With the aid of lantern slides he described and illustrated a compressor and indicator-cards taken therefrom at various pressures and speeds. The mechanical efficiency claimed was 87.91 per cent. and the volumetric 98.6 per cent., and indicator-cards were reproduced to support these claims. At the conclusion of the paper the general subject of air-compressors was discussed by Messrs. A. Falkenau, Francis Head, Francis Schumann and Fred W. Gordon.

Central Railway Club.

At the meeting of the Central Railway Club, held Sept. 14, which was the first meeting of the fall season, Prof. Gaetano Lanza of the Massachusetts Institute of Technology, read a paper on "Road Tests of Locomotives," which was later taken up for discussion. Mr. J. A. Bradley presented a report on the "Revised Rules of Interchange." Discussion was also held on the reports from the previous meeting, the first being "Best Form of Construction and Methods of Ventilating, Heating and General Equipment of Roundhouses."

The next meeting will be held at the Hotel Iroquois, Buffalo, N. Y., on Friday, Nov. 9, at 10 a. m. Prof. Hibbard, of Cornell University, has accepted an invitation to read a paper on a subject which will be announced later. The subject for committee report and discussion is as follows: "What Channels of Improvement Afford an Opportunity for Securing Greater Efficiency in the Present Air-Brake System." Committtee: Theo. H. Curtis, J. R. Petrie, J. W. Sheldon. At the November meeting the Executive Committee will also consider the advisability of establishing a Question Box. Any members having suggestions to offer are requested to send them to the President, H. F. Ball, Mechanical Engineer, Lake Shore & Michigan Southern Ry., Cleveland, Ohio, or to the Secretary.

Society of Naval Architects and Marine Engineers.

The eighth general meeting of the Society of Naval Architects and Marine Engineers will take place in New York City, at 10 a.m., Thursday, Nov. 15, 1900. Through the courtesy of the President and Managers of the American Society of Mechanical Engineers, the meetings will be held in the auditorium of No. 12 West Thirty-first street, the sessions continuing through Thursday and Friday, Nov. 15 and 16. There will be a banquet at Delmonico's at 7 p.m., Friday, Nov. 16. A list of the papers to be read at this meeting is attached, as follows:

Thursday.

Capacity Test of a Unique Form of Air Pump. By F. Meriam Wheeler, Esq., Member.

Interchangeability of Units for Marine Work. By W. D. Forbes, Esq., Member.

The United States Experimental Model Basin. By Naval Constructor D. W. Taylor, U. S. N., Member.

The Composition and Classification of Paints and Varnishes. By Prof. A. H. Sabin.

Tests of the Electric Plants of the Battleships Kearsarge and Kentucky. By Naval Constructor J. J. Woodward, U. S. N., Member.

Coaling of the U. S. S. Massachusetts at Sea. By Spencer Miller, Esq., Associate.

Friday.

Notes on Recent Improvements in Foreign Shipbuilding Plants. By Assistant Naval Constructor H. G. Gillmor, U. S. N., Member.

Can the American Shipbuilder under Present Conditions Compete with the British and German Shipbuilders in the Production of the Largest Class of Ocean Passenger and Freight Steamships? By George W. Dickie, Esq., Member of Council.

Classification Rules. By Theodore Lucas, Esq., Member.

Recent Designs of Battleships and Cruisers for the U. S. Navy. By Chief Constructor Philip Hichborn, U. S. N., Vice-President.

A Comparison of the Contract Prices of our Naval Vessels. By Harrison S. Taft, Esq., Associate.

Launch of a Cruiser and a Battleship. By James Dickie, Esq., Member.

The Safety of Torpedo-boats at Sea and in Action Under Various Conditions. By Naval Constructor Lloyd Bankson, U. S. N., Member.

PERSONAL.

(For other personal mention see Elections and Appointments.)

—Mr. Charles Wheeler, formerly Treasurer and Secretary of the Colorado & Southern, died recently in Denver, Col.

—Mr. Elton D. Walker, Assoc. M. Am. Soc. C. E., for several years Assistant Professor of Civil Engineering in Union College, has been appointed Assistant Professor of Civil Engineering in the Pennsylvania State College.

—Mr. Edward Curtis, Assistant Superintendent of the Hartford Division of the New York, New Haven & Hartford, died October 11. He was born in Lawrence, Mass., November 29, 1849, and began his railroad career with this company in 1875 as Clerk in the Superintendent's office.

—Mr. George N. Clayton, Northwestern Passenger Agent of the Wabash at Omaha, Neb., died Oct. 10. Mr. Clayton was born Nov. 10, 1847, at Pontiac, Mich. He was at various times connected with the Hannibal & St. Joe, and the Wabash, St. Louis & Pacific, and with its successor company, the Wabash.

—Mr. W. R. Omohundro, Patent Attorney, and member of the firm of Raymond & Omohundro, Chicago, died Thursday afternoon, Oct. 11, his death following an operation for appendicitis. Although but 39 years old, Mr. Omohundro had gained a wide reputation as a patent attorney and had a large acquaintance among railroad mechanical men and supply men.

—Mr. Frank G. Patterson, as already noted, becomes Vice-President and General Manager of the Pittsburgh, Johnstown, Ebensburg & Eastern. Mr. Patterson was born July 26, 1863. After being admitted to the bar in 1886 and practicing law for two years, he entered railroad service by assisting in survey and building of the Altoona & Mopsononock, and upon its completion was appointed Superintendent. In this capacity he continued for seven years. Afterwards he was made Receiver for the Altoona, Clearfield & Northern, and continued as such until its reorganization in 1897. He then became Superintendent of the Empire Transportation Co., with headquarters at Seattle, Wash. In April last he went to Cape Nome, Alaska, to look after mining interests and received his present appointment upon his return.

—Mr. John A. Middleton has recently been made Third Vice-President of the Erie Railroad, being already Third Vice-President of the New York, Susquehanna & Western, now an Erie line. Mr. Middleton is a native of the city of New York, received a collegiate education and took a law course at the University of Maryland and was admitted to the Maryland bar. He entered railroad service in 1880 as clerk in the President's office of the Atlanta & Charlotte. He then became clerk and chief clerk in the General Manager's office of the Richmond & Danville, where he remained under three administrators. Later he was chief clerk to the Second Vice-President, First Vice-President and President of the New York, Lake Erie & Western, and in 1895 was made Secretary of the Erie Railroad Company, of which he now becomes Third Vice-President. He is also a director and officer in several railroad and commercial corporations.

—Mr. John E. May, the new Superintendent of Car Service of the Chicago & Alton, at Bloomington, Ill., was born in New York in March, 1868. After two years at the Massachusetts Institute of Technology, Boston, he was for six months in 1887 on the engineering corps of the Pennsylvania R. R. In July the following year he entered the Auditing Department of the Chicago, Burlington & Quincy at Chicago, and continued with that company until June, 1895, serving in the General Passenger Department and in the General Freight Department, and finally being appointed Contracting Freight Agent in 1892 at Kansas City. From June, 1895, he was Superintendent and General Agent of the St. Clair, Madison & St. Louis, operating a bridge and belt line at Alton, Ill. After occupying that position for 4½ years, he entered the employ of his present company as Chief Clerk to the General Superintendent. His new appointment took effect Oct. 1.

—We published last week a sketch of the life of Mr. George R. Blanchard. Below are the resolutions adopted by the Western Trunk Line Committee:

Whereas, By the death of George R. Blanchard we are called to mourn the loss of an old and esteemed associate and friend; an able, conscientious and faithful worker; one who by his sterling manhood, his untiring efforts and redundant labors in the railroad cause has been the means of bringing the shipping public and railroad fraternity into closer unison, and raised the standard of his profession. Be it

Resolved, That we, the Executive and General Traffic Officers of Western and Northwestern railroad companies included in Western Trunk Line territory, give public expression to the personal loss which each has sustained, no less than the properties represented by us, and in general the traffic interests of the entire country.

Resolved, That the Chairman of the Western Trunk Line Committee be requested to convey to the family of the deceased an expression of our profound sympathy in their bereavement, and appreciation of the great loss which they and ourselves have sustained.

—Mr. Chas. A. Beach, on Oct. 1, became Superintendent of the Philadelphia Division of the Philadelphia & Reading at Philadelphia. He was born at Troy, N. Y., in October, 1859. He began railroad work at 14 as water boy on the gravel train of the Troy & Boston, where his father was Roadmaster. He served later as brakeman, baggage man and freight and passenger conductor on the Troy & Boston, the Delaware & Hudson Canal and the New York Central & Hudson River until 1890, when he was made Trainmaster of the New York Central at West Albany. The following year he was appointed Trainmaster at Utica, and the next year Assistant Superintendent, having charge of the freight service on the Western Division, where he remained two years. He was then promoted to Superintendent of the Lehigh Valley at Buffalo, where he remained 1½ years, and then for a similar period was General Superintendent of the South Jersey, after which he became Superintendent of Terminals of the Central of New Jersey, at Jersey City, N. J. On Sept. 1, this year, he was made Division Superintendent of the Atlantic City line of the Philadelphia & Reading, and a month later received his present advancement.

—We have already noted the appointment of Mr. D. F. Maroney as General Superintendent of the Pittsburgh Division and Branches, Baltimore & Ohio, effective Oct. 1. Mr. Maroney was born in Chicago, Ill., November, 1858, and began railroad work, at 14, as a messenger boy on the Chicago, Burlington & Quincy. He soon became a clerk and when he was about 20 he was called upon by Mr. Samuel Spencer, then Assistant to the President of the Baltimore & Ohio, for service in reorganizing the car record office of that road, of which department he was made Manager. In 1889 he was made Superintendent of Car Service and Assistant to the General Manager in charge of transportation, which position he filled until November, 1896, when he was made Superintendent of Transportation. The Division to which he is now appointed will be considerably increased by the absorption of the Pittsburgh & Western and Cleveland Terminal & Valley railroads, when Mr. Maroney's jurisdiction will extend from Cumberland, Md., to Fairmont and Wheeling, W. Va., and to Akron, Cleveland and Fairport, Ohio, and Kane, Pa. Mr. Maroney has been a careful student of his profession and for three years acted as editor of the *Railway Equipment Guide* in addition to his regular duties, and has written considerable in magazines on finance and railroad subjects.

ELECTIONS AND APPOINTMENTS.

Atchison, Topeka & Santa Fe.—Geo. C. Dillard has been appointed General Eastern Passenger Agent, with headquarters 377 Broadway, New York City, succeeding E. F. Burnett, resigned.

Atlanta, Knoxville & Northern.—We are informed that the various newspaper reports that F. K. Huger has accepted a position with this company are without foundation.

Boston & Maine.—H. E. Fisher, heretofore Assistant Treasurer, has been appointed Treasurer, succeeding A. Blanchard, resigned.

Central of Georgia.—At a meeting of the stockholders, held Oct. 9, E. T. Comer was elected a Director, succeeding the late H. M. Comer.

Chicago & Alton.—S. D. Kinney has been appointed Assistant Division Master Mechanic at Bloomington, Ill.

Chicago, Burlington & Quincy.—George Morton has been appointed Assistant General Freight Agent, with headquarters at Chicago, Ill.; effective Oct. 1.

Chicago, Milwaukee & St. Paul.—F. A. Miller, whose appointment as General Passenger Agent, succeeding Mr. Heafford, was noted Aug. 10, p. 545, assumed the duties of his new position on Oct. 15.

Colorado & Southern.—C. L. Wellington has been appointed Traffic Manager, succeeding B. L. Winchell, resigned.

Erie.—J. A. Middleton, heretofore Secretary, has been elected Third Vice-President, with headquarters at New York City.

Fitchburg (Boston & Maine).—At a meeting of the Directors, held Oct. 10, M. Williams was elected President.

Lake Erie & Western.—J. R. Smart has been appointed Superintendent of Dining Car Service.

Louisiana & Arkansas.—B. S. Atkinson, Assistant General Freight Agent, will, until further notice, assume the duties of Superintendent, owing to the serious illness of J. H. White.

Macon, Dublin & Savannah.—H. K. Deal has been appointed Assistant General Freight and Passenger Agent, with headquarters at Dublin, Ga.

Marquette & Southeastern.—The officers of this company, referred to in the Construction Column are: President and Treasurer, Wm. G. Mather, Cleveland, Ohio; Vice-President, E. R. Perkins, Cleveland, Ohio; Secretary, James H. Hoyt, Cleveland, Ohio; Manager, H. R. Harris, Marquette, Mich.

Missouri Pacific.—W. J. McKee has been appointed Superintendent, with headquarters at Little Rock, Ark., of the Arkansas Division and branches, and Arkansas Louisiana Ry., succeeding J. D. Moore, resigned. J. M. Walsh has been appointed Acting Superintendent of the Central Division and branches, with headquarters at Little Rock, succeeding Mr. McKee, effective Oct. 16.

National Tehuantepec.—F. Adams, heretofore Terminal Superintendent and Engineer of the Interoceanic of Mexico, has been appointed Manager and Chief Engineer of the port works for S. Pearson & Son, of London, England, who have the contract for rebuilding this line and its terminal harbors.

New York Central & Hudson River.—The headquarters of F. M. Whyte, Mechanical Engineer, have been removed from West Albany, N. Y., to 610 Grand Central Station, New York City.

New York, Chicago & St. Louis.—Henry V. Fountain has been appointed Auditor, succeeding James P. Curry, deceased; effective Oct. 10.

Norfolk & Western.—W. H. Barnes has been elected a Director, succeeding J. Kennedy Tod.

Northern Pacific.—E. C. Blanchard has been appointed Division Superintendent at Minneapolis, Minn., succeeding Mr. Law, promoted. Mr. Blanchard has been acting in that capacity since June 1, last.

Oregon Short Line.—G. H. Olmstead has been appointed Acting Superintendent at Pocatello, Idaho, succeeding L. Malloy, who has been granted an indefinite leave of absence.

Pennsylvania.—At a meeting of the Directors, held Oct. 10, the following appointments were confirmed, effective Dec. 1, in accordance with the amended organization, which provides for an additional Assistant Secretary, Assistant Transfer Clerk, and an Assistant to the Secretary: Robert H. Groff, Assistant Secretary, and John W. Marshall, Assistant Transfer Clerk, with headquarters at 128 Broadway, New York City, the stock Transfer Office which the company is about to establish. A. J. County is the new Assistant to the Secretary, with headquarters at Philadelphia, Pa.

Pittsburgh & Western.—The officers of this company are: Chairman of the Board, H. W. Oliver; President, John K. Cowen (President of the Baltimore & Ohio); Secretary, C. W. Wolford; Treasurer, W. H. Duffel, and Auditor, J. L. Kirk. The Directors are: Thomas M. King, D. F. Maroney and Johns McCleane, of Pittsburgh; Henry W. Oliver, Allegheny; William Salomon and Orland Smith, of New York, and John Barron. (See R. R. News column.)

Pittsburgh, Shawmut & Northern.—Wm. Singer has been appointed Master Car Builder, with headquarters at St. Mary's, Pa., succeeding F. A. Givin, whose title was Assistant Master Mechanic.

Port Arthur, Houston & Western.—The officers of this company, referred to in the Construction column, are: President, Wm. McDaniel; First Vice-President, E. L. Rothrock; Second Vice-President, George M. Craig; Secretary, C. M. Davis; Terasurer, Charles F. Ashley.

Seattle & International.—W. G. Pearce, Assistant to the President of the Northern Pacific, will also assume the duties of General Manager of the S. & I., succeeding L. S. Miller. Mr. Pearce has been acting in this capacity for some time. The title of G. B. Cliff, Master of Transportation, has been changed to Superintendent.

St. Louis & San Francisco.—C. R. Gray has been appointed Superintendent of Transportation at St. Louis, Mo. F. M. Bisbee, Superintendent of Track, Bridges and Buildings, having resigned, that position is abolished. F. W. Bond, heretofore Resident Engineer, has been appointed Chief Engineer, effective Oct. 15.

Union Pacific.—H. E. Flavin has been appointed Assistant Superintendent of the Colorado Division. This is a new position.

West Virginia & Southern.—J. M. Collins has been appointed Purchasing Agent, with headquarters at Marmet, W. Va.

RAILROAD CONSTRUCTION.

New Incorporations, Surveys, Etc.

ALABAMA ROADS.—A syndicate, headed by Russell A. Alger, of Detroit, is reported preparing to build a railroad from Foshee, Ala., south about 50 miles to Pensacola, Fla., running through timber lands.

ARCATA & MAD RIVER.—This California company is reported building a branch up Janes Creek to the falls of that stream, about two miles, into timber lands.

ARKANSAS SOUTHWESTERN.—Amended articles of incorporation have been filed with the Secretary of State of Arkansas for an extension from Pike City northwest about three miles to Murfreesboro. The capital stock is increased $36,000. (Oct. 12, p. 680.)

ATCHISON, TOPEKA & SANTA FE.—The contract is reported let for the Gulf, Colorado & Santa Fe extension of the Somerville-Conroes branch east to Silsbee Junction, Tex., to connect with the Gulf, Beaumont & Kansas City. (Sept. 21, p. 628.)

The city of Bakersfield, Cal., has granted right of way for additional trackage in that city.

ATLANTIC COAST LINE.—A spur is to be built, according to report, at Petersburg, Va., to reach a wharf on the Appomattox River.

BALTIMORE & OHIO.—W. E. Howley & Co. have been awarded the contract for a branch from Fairmount, W. Va., north 18 miles to Fairview. It is stated that two bridges will be required.

CHICAGO & NORTHWESTERN.—Contracts are reported let for bridges and grading on the Princeton & Northwestern extension from Princeton, Wis., northwest about 100 miles to the Chicago, St. Paul, Minneapolis & Omaha line at Marshfield. (Construction Supplement, July 27, 1900.)

CHICAGO, BURLINGTON & QUINCY.—Contracts are reported let for an extension of 180 miles from Guernsey, Wyo., west to the Elk Mountain coal fields.

CHOCTAW, OKLAHOMA & GULF.—The company has already raised about three miles of track on the Arkansas side of the Mississippi and east of the St. Francis Levee to a grade height above the new estimated flood line. The company is engaged jointly with the St. Francis Levee Board in raising the tracks from a point on the St. Francis Levee at Four-Mile Bayou, two miles westward. (Oct. 5, p. 662.) The embankment, when completed, will form a part o fthe new St. Francis Levee, now building. (Official.)

DULUTH & IRON RANGE.—Building is to be begun soon, according to report, on an extension north about 45 miles to Harding, Minn.

DULUTH, MISSABE & NORTHERN.—This company is reported about to build an extension from Mountain Iron, Minn., north about 35 miles.

FINLEYVILLE & LIBRARY.—This company was incorporated in Pennsylvania, Oct. 9, with a capital stock of $30,000, to build from Finleyville, on the Pennsylvania, north about three miles to Library. Selwyn M. Taylor, of Pittsburgh, is President.

GRAND TRUNK.—Building is reported begun on an extension at Meaford, Ont., to Meaford Harbor.

GREAT NORTHERN.—Negotiations are reported in progress for connecting the line with Victoria, B. C., and extending it across Vancouver Island to the west coast.

ILLINOIS CENTRAL.—The company is reported planning the building of a cut-off from Independence, Iowa, to run southeast about 125 miles to Clinton, to connect with a line from Fulton, Ill., on the opposite side of the river, to continue on southeast to Peoria. Such a line would effect a considerable saving from western points to the South.

KAHOLA & HILO.—Building is reported begun on this line in the Island of Hawaii, from Hilo, on the east side of the island, to run north and east along the coast through sugar plantations. The North American Trust Co. is reported to have taken $3,500,000 first mortgage bonds. Herbert B. Gehr, of Honolulu, is President. Jaudon Browne, 1006 Betz Bldg., Philadelphia, is General Manager. (Aug. 17, p. 560.)

KANSAS MIDLAND.—According to Kansas press reports, the St. Louis & San Francisco, which has recently bought this property, is to make extensive improvements. As recently noted, a portion of the proposed issue of bonds has been set aside for improvements.

KENTUCKY ROADS.—The North Jellico Coal Co. is reported to have begun work on a railroad between Woodbine and its mines on Indian Creek.

LONG ISLAND.—With reference to proposed improvements President Cassatt of the Pennsylvania is quoted by a Philadelphia paper as follows:

The Pennsylvania Railroad Co. contemplates the development of Long Island and the Long Island Railroad, first, by two or three tunnels under New York harbor to the island; secondly, by the establishment of railway terminals and a belt line for the breaking up of freight trains and the redistribution of merchandise in freight transportation, and, thirdly, by the development of a suburban district, both for manufacturing and for seashore and pleasure resorts to the east of Brooklyn and as far as it can be carried up the entire shore of Long Island. We shall aim to make Long Beach a second Atlantic City.

MARQUETTE & SOUTHEASTERN.—Surveys are in progress and building is to be begun as soon as possible on this line from Marquette, Mich., southeast about 25 miles. The line is to be built in the interest of the Cleveland-Cliffs Iron Co., Cleveland, Ohio. (Oct. 12, p. 680.) The officers are given under Elections and Appointments. (Official.)

MASON & OCEANA.—Grading is reported resumed on the extension of this line from Walkerville, Mich., south about 10 miles to Hesperia. About seven miles was graded several years ago. It is proposed to extend the line further south to Grand Rapids and to straighten the old track between Walkerville and Ludington.

MILWAUKEE, BERLIN & NORTHERN.—This company was incorporated in Wisconsin, Oct. 12, with a capital stock of $100,000, to build from Berlin, terminus of a branch of the Chicago, Milwaukee & St. Paul, northwest about 50 miles to Steven's Point. The directors are: Llewellyn Groff, Halgar Rommerdall, John S. Carter, Charles C. Bartlett, Christopher McLennan and Emanuel Hogenson, of Chicago, and W. W. Cooper, of Kenosha.

MISCELLANEOUS COMPANIES.—The Southwestern Construction Co., of Little Rock, Ark., has been incorporated, with a capital stock of $5,000, to build railroads. J. A. Woodson, Vice-President and General Manager of the Arkansas Southwestern, is President; P. R. Van Frank, Vice-President.

The International Rapid Transit Co., of Buffalo, N. Y., was incorporated in Delaware, Oct. 15, with a capital of $1,000,000, to build and maintain railroads, tunnels, bridges, etc.

NASHVILLE, CHATTANOOGA & ST. LOUIS.—An extension is announced from Bon Air, Tenn., to run to Green Place, about 17 miles. (Construction Supplement, July 27, 1900.)

NEW YORK CENTRAL & HUDSON RIVER.—With reference to the reported double tracking of the Pennsylvania Division, an officer writes that the company has no intention of double tracking except at special points where from two to four miles of double track are being put in.

NORFOLK & WESTERN.—An officer writes that Walton & Co., Falls Mills, Va., have the contract for two miles of second track near Bluestone Junction, Va. (Oct. 5, p. 662.)

NORTHERN PACIFIC.—Surveys are reported in progress for a spur from Bismarck, N. Dak., south to Fort Abraham Lincoln.

PENNSYLVANIA.—Surveys are reported in progress for an extension of the Penngrove Branch of the West Jersey & Seashore line south to South Penngrove, N. J.

Building is reported in progress on a four-mile branch from Safe Harbor to the Segal iron mines.

PENNSYLVANIA ROADS.—The Sharon Steel Co. is reported about to build a railroad from its works in South Sharon southeast via Bethel, New Wilmington and Volant to Leesburg, connecting with coal mines and stone quarries of the company.

PHILADELPHIA & READING.—Plans are reported consummated for a branch from Burleigh, N. J., southeast about five miles to Holly Beach.

PITTSBURGH & LAKE ERIE.—Extensive additions are to be made, according to report, to the yards at Haselton, Ohio.

PORT ARTHUR, HOUSTON & WESTERN.—This company has been incorporated in Texas, with a capital stock of $200,000, to build a railroad from Port Arthur, on the Gulf, west about 80 miles to Houston. The general offices are at Port Arthur. The officers are given under Elections and Appointments.

RIO GRANDE WESTERN.—Building is begun on the main line at Roper, Utah, to Mill Creek, on the Utah Central, 3.3 miles. A. Holt & Sons, of Salt Lake City, have the contract. (Sept. 28, p. 644.) The maximum grade is 1.9 per cent. (Official.)

ST. LOUIS & SAN FRANCISCO.—Building is reported begun on an extension at Sherman, Tex.

SOUTHPORT, WILMINGTON & WESTERN.—Langstaff Johnson, of Richmond, Va., is reported to be about to make surveys for this proposed line from Wilmington, N. C., south about 25 miles to Southport. Chas. N. Wire, Philadelphia, and Wm. A. Guthrie, of Durham, N. C., are incorporators. (Construction Supplement, July 27, 1900.)

SOUTH SHORE (CANADA).—The company has decided to extend its line on from Yamaska, Que., northeast about 140 miles to Levis. (Construction Supplement, July 27, 1900.)

TEXAS SOUTHEASTERN.—This company was incorporated in Texas, Oct. 9, with a capital stock of $100,000, to build a railroad from Diboll, on the Houston East & West Texas, to run east 15 miles to Lindsay. The incorporators are: T. L. L. Temple, C. M. McWilliams, W. J. Williams, Charles Frederick, Watson Walker, W. P. Rutland and William Ashford.

WEST BRANCH VALLEY.—Orders are reported placed for rails and structural iron for this proposed line from Clearfield, Pa., east 104 miles to Williamsport. It is understood to be backed by the Buffalo, Rochester & Pittsburgh. A. E. Patton, Curwensville, Pa., is President. (Construction Supplement, July 27, 1900.)

WEST VIRGINIA ROADS.—The United States Construction Co., of Cleveland, Ohio, is reported to have a contract for building the line from Williamstown, on the Ohio River, to run south about 100 miles to Summerville. It is understood that the road will be connected with an extension in Ohio to Cleveland. Thomas F. Barrett, of Parkersburg, is interested.

WILMINGTON & WESTCHESTER.—The company has made application to the city of Wilmington, Del., for right of way for its proposed line from Westchester south 9¾ miles to the Delaware state line, and thence to Wilmington. James H. Hoffeker, Jr., of Wilmington, Del., is President. (Construction Supplement, July 27, 1900.)

GENERAL RAILROAD NEWS.

CHICAGO, BURLINGTON & QUINCY.—The New York Stock Exchange has listed $10,048,000 additional Illinois Division 3½ per cent. bonds of 1948, making a total listed of $26,214,000. Of these new bonds $4,972,000 will take the place of consolidated mortgage 7s, due July 1, 1903, which have been canceled; $5,076,000 will be used toward the purchase of securities of the Keokuk & Western, and for 250 miles of new railroad completed west of the Missouri River.

CHICAGO TERMINAL TRANSFER.—The New York Stock Exchange has listed $400,000 additional mortgage 4 per cent. gold bonds of 1947 for track elevations, extensions and improvements completed at and near Chicago.

PENNSYLVANIA.—The Board of Directors, on Oct. 10, elected an additional Assistant Secretary, an additional Assistant Transfer Clerk and an Assistant to the Secretary for the new stock transfer office to be opened at 128 Broadway, New York, Dec. 1. (June 1, p. 36.)

PITTSBURGH & WESTERN.—The receiver (Mr. T. M. King) was discharged by Judge Joseph Buffington, at Pittsburgh, Pa., Oct. 15, and the property has been taken over by the Baltimore & Ohio. (Oct. 12, p. 680.)

ST. LOUIS & SAN FRANCISCO.—At a special meeting of the stockholders, on Oct. 10, the Directors were authorized to acquire the property of the Kansas Midland, and an issue of $1,800,000 4 per cent. bonds was authorized, of which $1,100,000 will be paid for the property and $700,000 reserved for improvements and additions. (K. M., Aug. 3, p. 532.)

SIERRA VALLEYS.—This property, which runs from Plumas, Cal., on the Nevada-California-Oregon line, west 30.7 miles to Clairville, has been sold at sheriff's sale to the Southern Pacific, on a judgment of $2,883 obtained by Marion C. Bringham for labor and supplies furnished during the building of the road.

TOLEDO, ST. LOUIS & KANSAS CITY.—The fourth installment of $5 on the preferred, and $3 per share on the common, is called for payment at the Central Trust Co., on or before Oct. 25. (Sept. 21, p. 628.)

TOLEDO & OHIO CENTRAL.—This company, operating one of the important lines in the Hocking soft coal district in Southern Ohio, reports the largest earnings in its history in the year to June 30. On 371 miles of track, gross receipts were $2,368,972 and net earnings $746,252. This was an increase of 25 per cent. in gross and of 38½ per cent. in net. Gross earnings per mile were $6,378, against $5,110 per mile in 1899. Most of the increase in gross earnings, $449,000 out of the total gain of $471,100, was in freight. These receipts were one-third larger than last year, mostly due to the heavier tonnage of soft coal and the increase in average rates. The company carried last year, 3,097,000 tons of freight, of which soft coal comprised 68½ per cent. and contributed 558,000 tons of the total increase of 665,000 tons in freight traffic. Naturally the company has a dense traffic as have all of the Western soft coal carrying lines and its train load is large and growing, while its train-mile earnings made a good showing, despite the low rate. Thus, last year the increase in tonnage moved of 21½ per cent. gave an increase of 32.2 per cent. in ton miles, which ran up to the exceptionally high figure of 1,106,000 ton-miles moved per mile of road. The ton-mile rate was only 4.41 mills, but this was an increase of over 6⅞ per cent. as compared with the rate last year, while the freight train-mile receipts were 15½ per cent. above last year's figure at $1.58. The average freight trainload increased 15 per cent. and is now 359 tons, a large figure, but the Hocking Valley, which, within the past year has secured control of the Toledo & Ohio Central, itself reports an average train load of 646 tons in 1900.